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mercruiser

SERVICE MANUAL

Number 7

MARINE ENGINES

GM V-6 Cylinder

Printed in U.S.A.

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90-12410 2-1293

Models Covered in This Manual

MODEL	SERIAL NUMBER
MCM 185R 229 CID (3.8L)	6289593 - 6919655
MCM 185MR 262 CID (4.3L)	6919656-OA483580
MCM 185 Alpha I	OA483581 - OB455459
MCM 175 Alpha I	OB455460 - OB773242
MCM 4.3 Litre Alpha I	OB773243 - OF000000
Sea Ray (Note 1) 4.3L-2 Alpha I	OB785483 - B921276
MCM 205MR	6919687 - OA483776
MCM 205 Alpha I	OA483777 - OB775129
MCM 4.3 Litre LX Alpha I	OB775130 - OF000000
Sea Ray (Note 1) 4.3L-4 Alpha I	OB785981 - B922330

NOTE 1: Sea Ray to MerCruiser cross references are;
4.3L-2 same as MCM 4.3 Litre
4.3L-4 same as MCM 4.3 Litre LX

IMPORTANT: Refer to engine identification, page 2.

NOTICE
Refer to Appropriate Stern Drive service manual for transom assembly and Stern Drive unit repair.

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Notice

Throughout this publication, "Dangers", "Warnings" and "Cautions" are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. —— Observe them carefully!

These "Safety Alerts" alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus "common sense" operation, are major accident prevention measures.

⚠DANGER

DANGER — Immediate hazards which WILL result in servere personal injury or death.

⚠WARNING

WARNING — Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠CAUTION

CAUTION — Hazards or unsafe practices which could result in minor personal injury of product or property damage.

Notice To Users of This Manual

This service manual has been written and published by the service department of Mercury Marine to aid our dealers mechanics and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures of these products, or like or similar products manufactured and marketed by Mercury Marine. That they have been trained in the recommended servicing procedures of these products which includes the use of mechanics common hand tools and the special Mercury Marine or recommended tools from other suppliers.

We could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a service procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the product's safety will be endangered by the service procedure selected.

All information, illustrations and specifications contained in this manual are based on the latest product information available at time of publication.

It should be kept in mind, while working on the product, that the electrical system and ignition system is capable of violent and damaging short circuits or severe electrical shocks. When performing any work where electrical terminals could possibly be grounded or touched by the mechanic, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings are exposed during service they should be covered to protect against accidental entrance of foreign material which could enter the cylinders and cause extensive internal damage when the engine is started.

It is important to note that, during any maintenance procedure, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. Numbers on the heads of the metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings. Mismatched or incorrect fasteners can result in damage or malfunction, or possibly personal injury. Therefore, fasteners removed should be saved for re-use in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original.

Replacement Parts

⚠WARNING

Electrical, ignition and fuel system components on MerCruiser Engines and Stern Drives are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire or explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply to these rules and regulations, could result in a fire or explosion hazard and should be avoided.

When servicing the electrical, ignition and fuel systems, it is extremely important that all components are properly installed and tightened. If not, any electrical or ignition component opening would permit sparks to ignite fuel vapors from fuel system leaks, if they existed.

Engine Mechanical Components

Many of the engine mechanical components are designed for marine applications. Unlike automotive engines, marine engines are subjected to extended periods of heavy load and wide-open-throttle operation, therefore, require heavy-duty components. Special marine engine parts have design and manufacturing specifications which are required to provide long life and dependable performance. Marine engine parts also must be able to resist the corrosive action of salt or brackish water that will rust or corrode standard automotive parts within a short period of time.

Failure to use recommended Quicksilver service replacement parts can result in poor engine performance and/or durabilty, rapid corrosion of parts subjected to salt water and possibly complete failure of the engine.

Use of parts other than recommended service replacement will void the warranty on those parts which are damaged as a result of the use of other than recommended parts.

Service Manual Outline

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- C - Troubleshooting

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  4.3L, 4.3LX (262 C.I.D.)

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- B - Closed Cooling
- C - Exhaust System

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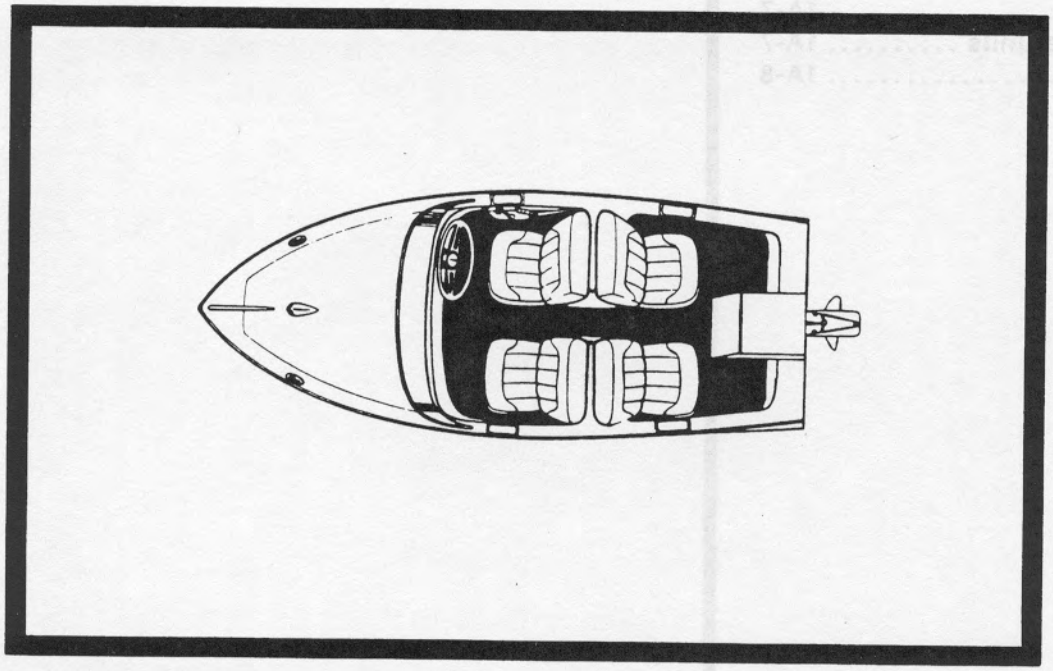
IMPORTANT INFORMATION

1
A



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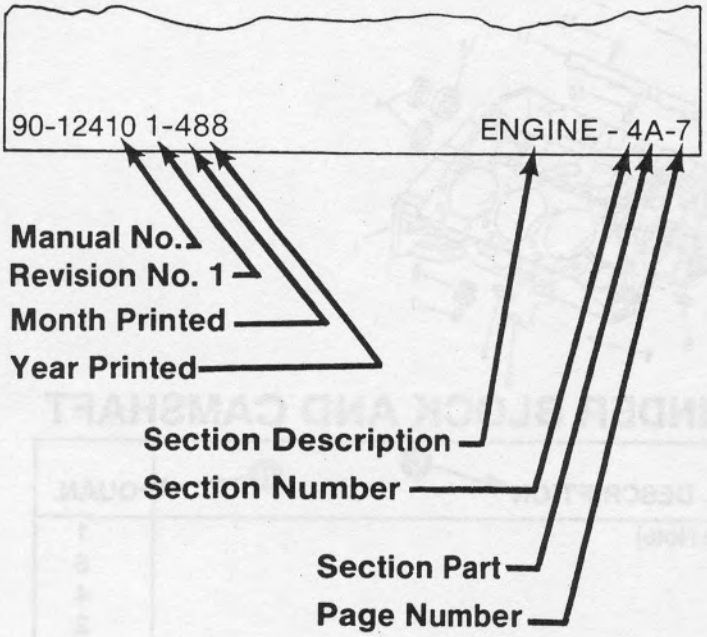
How to Use This Manual

This manual is divided into sections which represent major components and systems.

Some sections are further divided into parts which more fully describe the component.

Page Numbering

Two number groups appear at the bottom of each page. Following is an example and description.

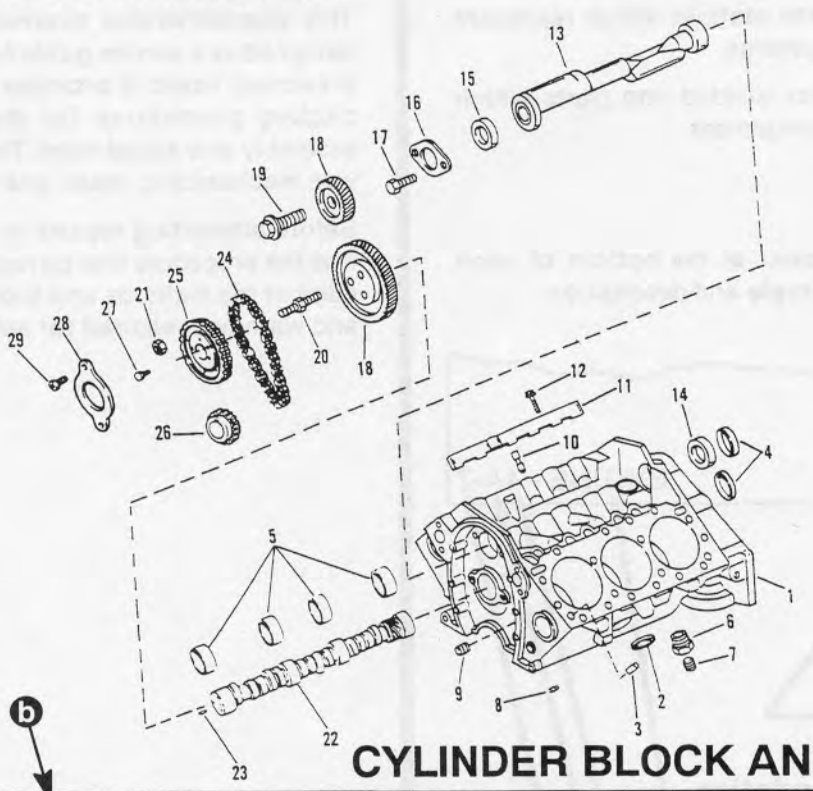


Introduction

This comprehensive overhaul and repair manual is designed as a service guide for the MerCruiser models previously listed. It provides specific information, including procedures for disassembly, inspection, assembly and adjustment. To enable dealers and service mechanics to repair and tune these engines.

Before attempting repairs or tune up, it is suggested that the procedure first be read through to gain knowledge of the methods and tools used and the cautions and warnings required for safety.

How To Read Parts Manual



CYLINDER BLOCK AND CAMSHAFT

PART NO. (a)	REF. NO. (b)	DESCRIPTION (c)	QUAN. (d)
● 841-824146	1	CYLINDER BLOCK (See Note)	1
19-34270	2	EXPANSION PLUG	8
17-35465	3	DOWEL PIN	4
22-72640	4	EXPANSION PLUG	2
23-85674	5	BEARING UNIT (SET)	1
22-48556	6	BUSHING	2
22-32802	7	PIPE PLUG	1
22-42796	8	BY-PASS VALVE	1
19-816565	9	PLUG	1
811844	10	LIFTER	12
● 824331	11	RETAINER	2
● 10-824332	12	SCREW	4
● 824148	13	BALANCED SHAFT	1
● 31-824150	14	BEARING (REAR)	1

(e) NOTE: 841-824146 Cylinder Block includes only standard pistons, piston rings, crankshaft bearings and camshaft bearings.

A. **Part Number:** For part ordering - Note N.S.S. for Reference Numbers, (not shown above) - means Not Sold Separately by Mercury Marine, however, in some cases, the G.M. Part Number (for the item) is given in the Description Column.

B. **Reference Number:** For part Shown on exploded parts view.

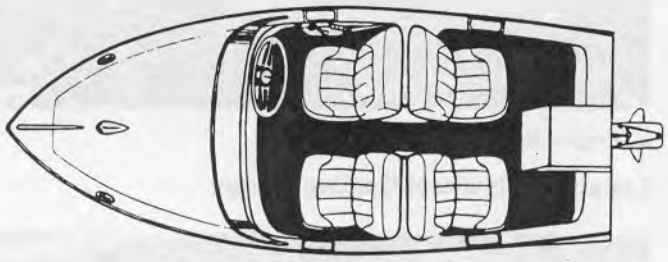
C. **Description:** This is the most important column because it gives:
1) Description of Part: Ref. No. 1 is a Cylinder Block Assembly, No. 13 is the Balanced Shaft, etc.
2) What parts are included with a certain part: Notice how the Description of Part, for Ref. Nos. 1, and 10 through 13, are at the left side of the column. Description of Part for Ref. Nos. 2 thru 9 are indented under "Cylinder Block". If Ref. No. 1 (Cylinder Block) was ordered, all indented parts (Ref. Nos. 2 thru 9) would come with the part. Ref. Nos. 10 thru 14 would not come with Ref. No. 1 and would have to be ordered separately. If 2 Cylinder Blocks were listed, both cylinder blocks would come with the indented parts. In some cases, an indented part will have another part indented under it. The second indented part will come with the first indented part.
3) Serial number break: If serial number information is listed, check product serial number to ensure that correct part is ordered.
4) Special information: Many times special information will be shown after description such as; L.H. Rotation, R. H. Rotation, Filter up, Filter Down, etc. This will help in selecting the correct part.

D. **Quantity:** Quantity that has to be ordered.

E. **Special Information Block:** Additional information, part numbers for gasket sets, etc.

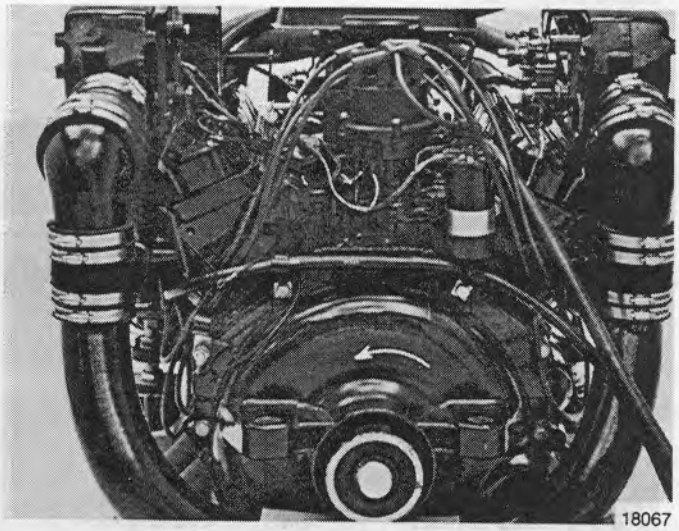
Directional References

Front of boat is bow; rear is stern. Starboard side is right side; port side is left side. In this maintenance manual, all directional references are given as they appear when viewing boat from stern, looking toward bow.



Engine Rotation

Engine rotation is determined by observing flywheel rotation from the rear (stern drive end) of the engine looking forward (water pump end). Propeller rotation is not necessarily the same as engine rotation. When ordering replacement engine, short blocks or parts for engine, be certain to check engine rotation. Do not rely on propeller rotation in determining engine rotation.


18067

Engine Identification

Serial Number Locations

185R (229 CID) 3.8 LITER

15768

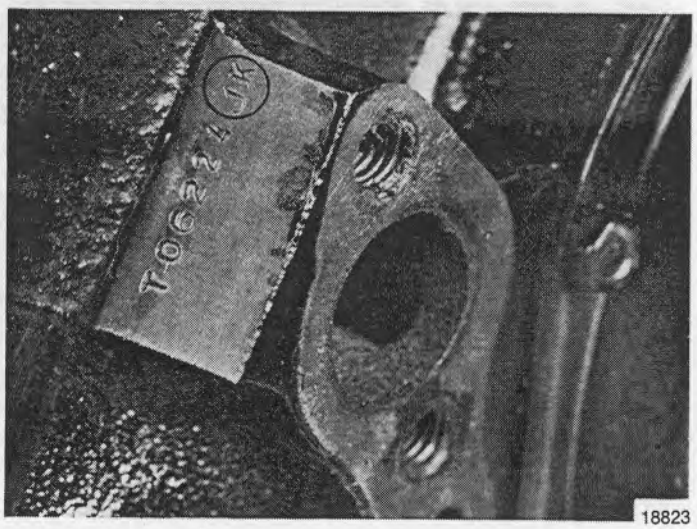
a - Engine Specifications and Serial Number Decal

Location: Rocker Arm Cover

16727

a - Engine Serial Number Plate

Location: Flywheel Casting Flange



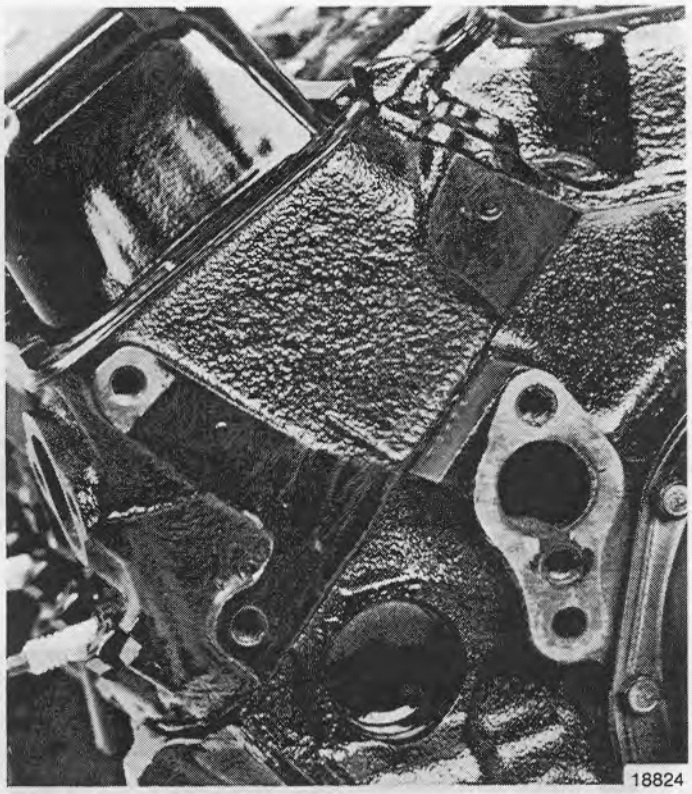
18823

Engine Designation
Last Two Letters = JK
Designate 185R Engine

Location: Water Pump Boss

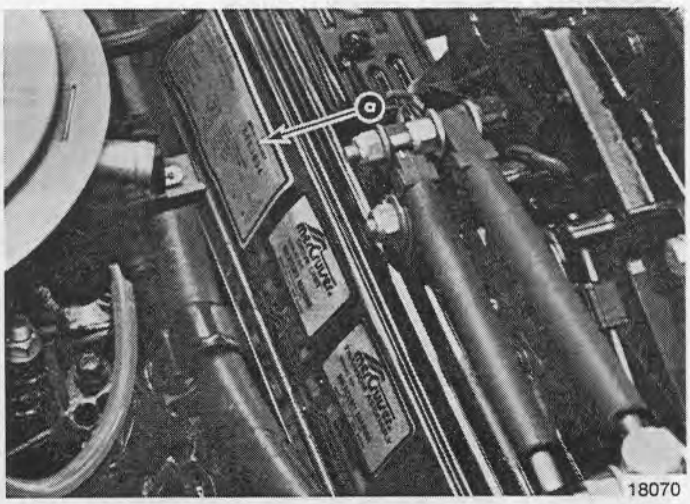
Cylinder Head Identification

185R (229 CID)



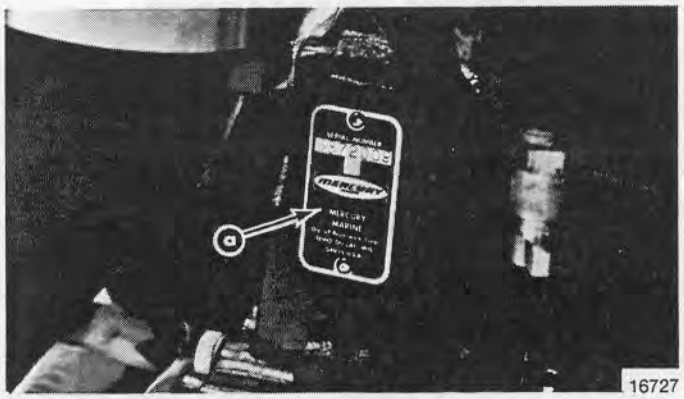
185MR-205MR

(262 CID) 4.3 LITER



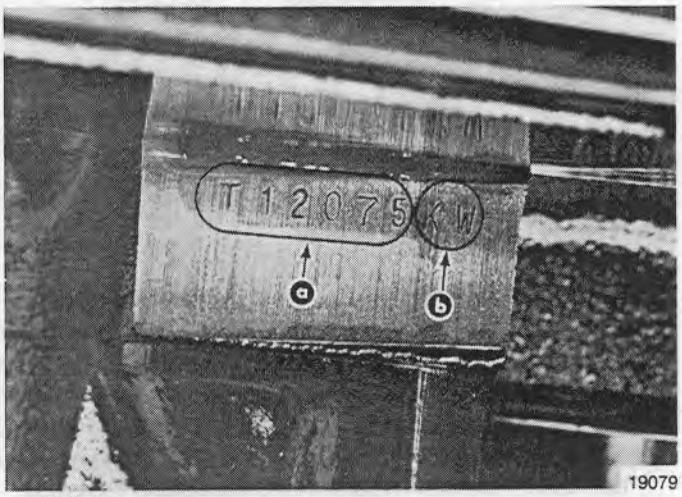
a - Engine Specifications and Serial Number Decal

Location: Rocker Arm Cover

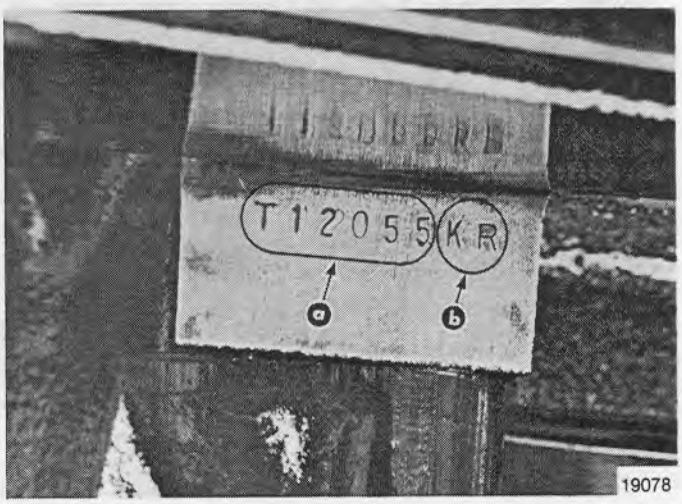


a - Engine Serial Number Plate

Location: Flywheel Casting Flange

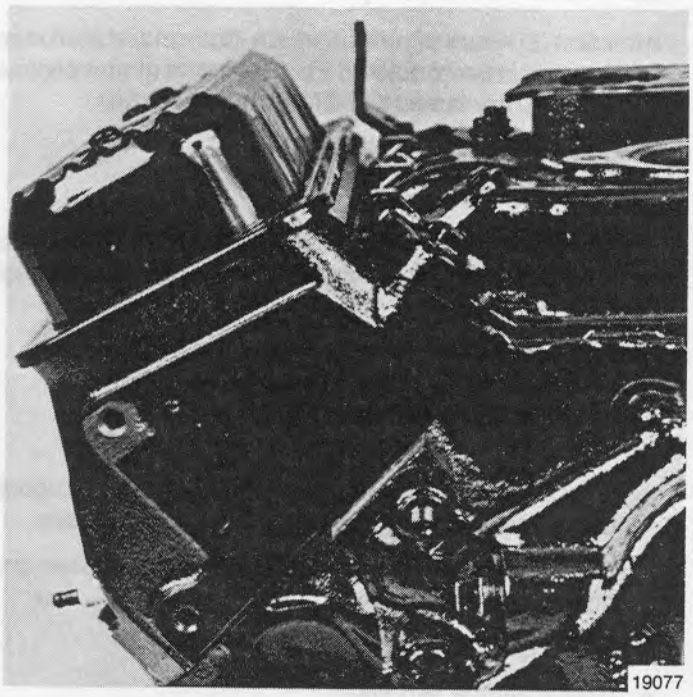


Engine Designation
Last Two Letters = KW
Designate 185MR Engine
KP Letters designates 175, 4.3 Liter



Last Two Letters = KR
Designate 205MR, 4.3 Litre LX Engines

Location: Water Pump Boss



Propeller Information

Order publication P/N 90-86144 "What You Should Know About Quicksilver Propellers . . . and Boat Performance Information".

Changing diameter, pitch or coupling a propeller will effect engine RPM and boat performance. The blade configuration will also effect performance. Two like propellers, same pitch and diameter, from two different manufacturers will also perform differently.

It is the responsibility of the boat and/or selling dealer to equip the boat with the correct propeller to allow the boat motor to operate within its specified RPM range at wide open throtle (W.O.T).

Because of the many variables of boat design and operation only testing will determine the best propeller for the particular application.

To test for correct propeller, operate boat (with an average load onboard) at W.O.T. and check RPM with an accurate tachometer. Engine RPM should be near top of the specified range so that under heavy load engine speed will not fall below specifications.

If engine exceeds the recommended RPM, an increase in pitch and/or diameter is required.

If engine is below rated RPM, a decrease in pitch and/or diameter is required.

Normally a change of approximately 300 to 500 RPM will be achieved for each single pitch change of propeller.

⚠CAUTION

If a propeller is installed that does not allow engine RPM to reach the specified full-throttle RPM range, the engine will "labor" and will not produce full power. Operation under this condition will cause excessive fuel consumption, engine overheating and possible piston damage (due to detonation). On the other hand, installation of a propeller, that allows engine to run above the specified RPM limit, will cause excessive wear on internal engine parts which will lead to premature engine failure.

Hi-Performance Boating

For a book entitled "Hi-Performance Boat Operation", which is written by Marine Engineers order publication P/N 90-86168.

Engine 20-Hour Break-In Period

IMPORTANT: Proper break-in is essential to obtaining minimum oil consumption, maximum engine performance and service.

The first 20 hours of operation is the engine (new or rebuilt) break-in period. During this period, it is extremely important that the engine is operated, as outlined in the following information.

1. Do not operate engine below 1500 RPM for extended periods of time during the first 10 hours. During this period, shift into gear as soon as possible after starting engine and advance throttle so that RPM is above 1500 (provided that conditions permit safe operation at this speed).
2. Do not operate at any one constant speed for extended periods of time.
3. Do not exceed 3/4 of full throttle during the first 10 hours of operation. During the next 10 hours, occasional operation at full throttle (5 minutes at-a-time maximum) is permissible.
4. Avoid full throttle acceleration from stopped position.
5. Do not operate at full throttle until engine reaches normal operating temperature.
6. Observe instrumentation carefully. If an abnormal reading occurs, stop engine immediately and determine cause.
7. Frequently check crankcase oil level and add oil if necessary. It is normal for oil consumption to be somewhat high during the break-in period.
8. At end of 20-hour break-in period, drain break-in oil from crankcase and replace oil filter. Fill crankcase with correct grade and viscosity oil.

20-Hour Checkup

After first 20 hours of operation, an Authorized MerCruiser Dealer should be contacted for the following maintenance. The boat owner is responsible for any charges.

- Change crankcase oil and filter.
- Check all fluid levels.
- Cooling Systems - Inspect all hoses for damage and deterioration; check all hose clamps for adequate tightness.
- Check carburetor adjustment.
- Inspect ignition system and timing.
- Check for loose, missing or damaged parts.
- Check shift and throttle cable adjustments - Lubricate and inspect for loose, damaged or missing parts.
- Steering System - Lubricate and inspect for loose, damaged or missing parts.
- Inspect all drive belts.
- Check engine alignment.
- Complete Engine Exhaust System – Inspect for damage and deterioration; check all hose clamps for adequate tightness.
- Retorque gimbal ring clamping U-bolt to 55 lb. ft. (74 N•m).

Water Testing New Engines

Care must be exercised during the first 20 hours of operation on new MerCruisers or possible engine failure may occur. If a new engine has to be water-tested at full throttle before the break-in period is complete, follow this procedure.

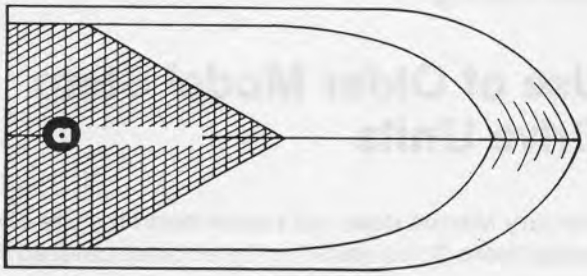
1. Start engine and run at idle RPM until normal operating temperature is reached.
2. Run boat up on plane.
3. Advance engine RPM (in 200 RPM increments) until engine reaches its maximum rated RPM.

IMPORTANT: Do not run at maximum RPM for more than 2 minutes.

Boat and Engine Performance

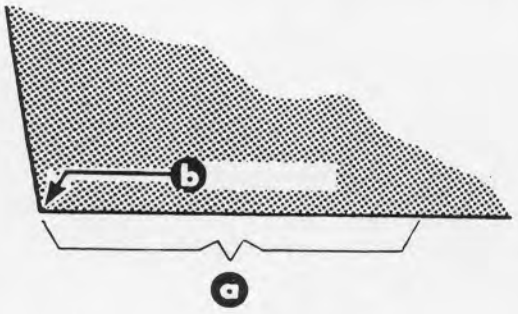
Boat Bottom

For maximum speed, a boat bottom should be as flat as possible in a fore-aft direction (longitudinally) for approximately the last 5 ft. (1.5m).



a - Critical Bottom Area

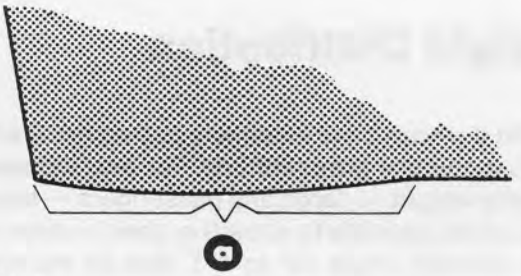
For best speed and minimum spray the corner between the bottom and the transom should be sharp.



a - Flat
b - Sharp Corner

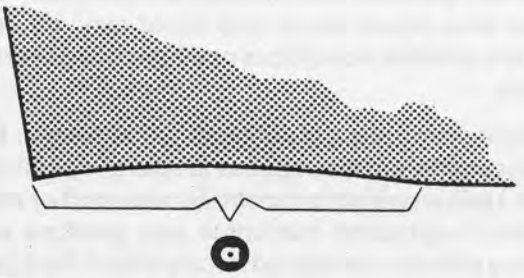
A "rocker" is the reverse of a hook. The bottom is convex or bulged in the fore-and-aft direction. It can cause the boat to porpoise.

Any hook, rocker or surface roughness on the bottom, particularly in the all-important center-aft portion will have a negative effect on speed, often several miles-per-hour on a fast boat.



a - Rocker

The bottom is referred to as having a "hook" if it is concave in the fore-and-aft direction. A hook causes more lift on the bottom near the transom and forces the bow to drop. This increases wetted surface and reduces boat speed, but it helps planing and reduces any porposing (rythmical bouncing) tendency. A slight hook is often built in by the manufacturer. A hook can also be caused by not trailering or storing the boat with support directly under the transom.



a - Hook

Marine Fouling

Fouling is an unwanted buildup (usually animal-vegetable-derived) occuring on the boats bottom and drive unit. Fouling adds up to drag, which reduces boat performance. In fresh water, fouling results from dirt, vegetable matter, algae or slime, chemicals, minerals and other pollutants. In salt water, barnacles, moss and other marine growth often produce dramatic build-up of material quickly. So it's important to keep the hull as clean as possible in all water conditions to maximize boat performance.

Special hull treatments, such as antifouling paint, will reduce the rate of bottom fouling. However, due to the fact that drive units (outboard or stern drive) are made primarily of aluminum, be sure to select an antifouling paint having a copper-free, organo-tin base. The BIS (Tri Butyl Tin) Adipate (TBTA) base paint will not set up a galvanic corrosion "cell" as it is completely compatible with aluminum and avoids any electrolysis problems connected with many other paints. Applied according to instruction, it is also very effective.

Weight Distribution

Weight distribution is extremely important; it affects a boat's running angle or attitude. For best top speed, all movable weight — cargo and passengers — should be as far aft as possible to allow the bow to come up to a more efficient angle (3° to 5°). But on the negative side of this approach is the problem that, as weight is moved aft, some boats will begin an unacceptable porpoise.

Secondly, as weight is moved aft, getting on plane becomes more difficult.

Finally, the ride in choppy water becomes more uncomfortable as the weight goes aft. With these factors in mind, each boater should seek out what weight locations best suit his needs.

Weight and passenger loading placed well forward increases the "wetted area" of the boat bottom and, in some cases, virtually destroys the good performance and handling characteristics of the boat. Operation in this configuration can produce an extremely wet ride, from wind-blown spray, and could even be unsafe in certain weather conditions or where bow steering may occur.

Weight distribution is not confined strictly to fore and aft locations, but also applies to lateral weight distribution. Uneven weight concentration to port or starboard of the longitudinal centerline can produce a severe listing attitude that can adversely affect the boat's performance, handling ability and riding comfort. In extreme rough water conditions, the safety of the boat and passengers may be in jeopardy.

Water in Boat

When a boat looses performance the bilge should be checked for water. Water can add considerable weight to the boat thereby decreasing the performance and handling.

Make certain that all drain passages are open for complete draining.

Use of Older Model Stern Drive Units

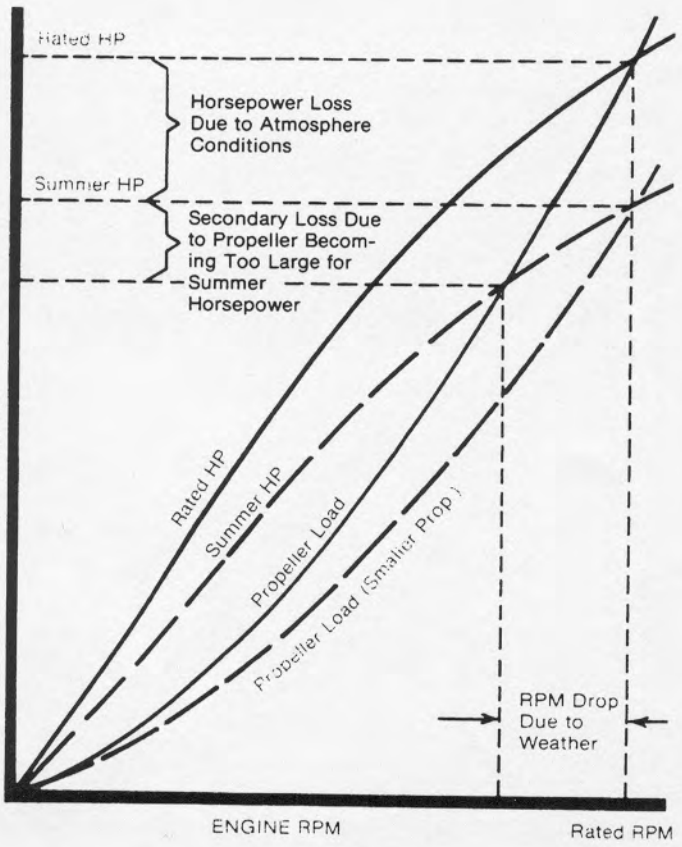
Mercury Marine does not recommend the use of older model Stern Drive units for the engines covered in this manual.

IMPORTANT: Use of an older model Stern Drive unit on a new model will result in a spline failure to coupling and/or yoke.

Elevation and Climate

Elevation has a very noticeable effect on the wide-open throttle power of an engine. Since air (containing oxygen) gets thinner as elevation increases, the engine begins to starve for air. Humidity, barometric pressure and temperature do have a noticeable effect on the density of air. Heat and humidity thin the air. This phenomenon can become particularly annoying when an engine is propped out on a cool, dry day in spring and later, on a hot, sultry day in August, doesn't have its old zip. (See chart)

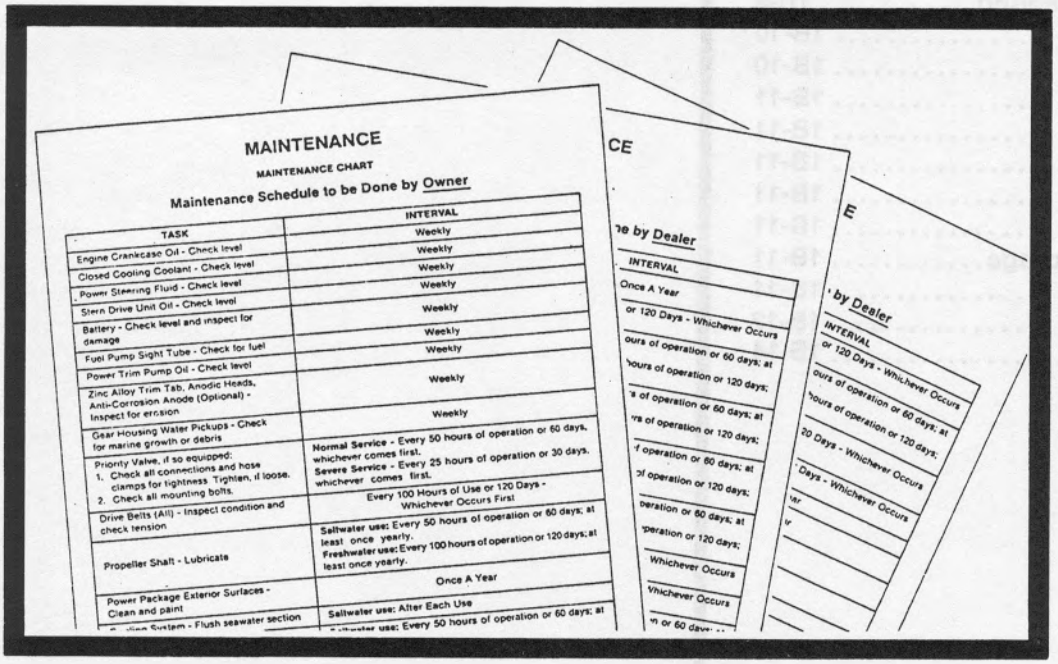
Although some performance can be regained by dropping to a lower-pitch propeller, the basic problem still exists. The propeller is too large in diameter for the reduced power output. The experienced marine dealer or a Quicksilver Propeller Repair Station can determine how much diameter to remove from a lower-pitch propeller for specific high-elevation locations. In some cases, a gear-ratio change to the drive unit to more reduction is possible and very beneficial. It is a known fact that weather conditions exert a profound effect on power output of internal combustion engines. Therefore, established horsepower ratings refer to the power that the engine will produce at its rated RPM under a specific combination of weather conditions.



MAINTENANCE

1

B



MAINTENANCE

MAINTENANCE CHART

Maintenance Schedule to be Done by Owner

TASK	INTERVAL
Engine Crankcase Oil - Check level	Weekly
Closed Cooling Coolant - Check level	Weekly
Power Steering Fluid - Check level	Weekly
Stern Drive Unit Oil - Check level	Weekly
Battery - Check level and inspect for damage	Weekly
Fuel Pump Sight Tube - Check for fuel	Weekly
Power Trim Pump Oil - Check level	Weekly
Zinc Alloy Trim Tab, Anodic Heads, Anti-Corrosion Anode (Optional) - Inspect for erosion	Weekly
Gear Housing Water Pickups - Check for marine growth or debris	Weekly
Priority Valve, if so equipped: 1. Check all connections and hose clamps for tightness. Tighten, if loose. 2. Check all mounting bolts.	**Normal Service** - Every 50 hours of operation or 60 days, whichever comes first. **Severe Service** - Every 25 hours of operation or 30 days, whichever comes first.
Drive Belts (All) - Inspect condition and check tension	Every 100 Hours of Use or 120 Days - Whichever Occurs First
Propeller Shaft - Lubricate	**Saltwater use:** Every 50 hours of operation or 60 days; at least once yearly. **Freshwater use:** Every 100 hours of operation or 120 days; at least once yearly.
Power Package Exterior Surfaces - Clean and paint	Once A Year
[illegible] System - Flush seawater section	**Saltwater use:** After Each Use **Saltwater use:** Every 50 hours of operation or 60 days; at

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MAINTENANCE

MAINTENANCE CHART

Maintenance Schedule to be Done by Owner

TASK	INTERVAL
Engine Crankcase Oil - Check level	Weekly
Closed Cooling Coolant - Check level	Weekly
Power Steering Fluid - Check level	Weekly
Stern Drive Unit Oil - Check level	Weekly
Battery - Check level and inspect for damage	Weekly
Fuel Pump Sight Tube - Check for fuel	Weekly
Power Trim Pump Oil - Check level	Weekly
Zinc Alloy Trim Tab, Anodic Heads, Anti-Corrosion Anode (Optional) - Inspect for erosion	Weekly
Gear Housing Water Pickups - Check for marine growth or debris	Weekly
Priority Valve, if so equipped: 1. Check all connections and hose clamps for tightness. Tighten, if loose. 2. Check all mounting bolts.	**Normal Service** - Every 50 hours of operation or 60 days, whichever comes first. **Severe Service** - Every 25 hours of operation or 30 days, whichever comes first.
Drive Belts (All) - Inspect condition and check tension	Every 100 Hours of Use or 120 Days - Whichever Occurs First
Propeller Shaft - Lubricate	**Saltwater use:** Every 50 hours of operation or 60 days; at least once yearly. **Freshwater use:** Every 100 hours of operation or 120 days; at least once yearly.
Power Package Exterior Surfaces - Clean and paint	Once A Year
Cooling System - Flush seawater section	**Saltwater use:** After Each Use
Power Package Exterior Surfaces - Spray with rust preventive	**Saltwater use:** Every 50 hours of operation or 60 days; at least once yearly. **Freshwater use:** Every 100 hours of operation or 120 days; at least once yearly.

MAINTENANCE
(Continued)

MAINTENANCE CHART
(Continued)

Maintenance Schedule to be Done by Dealer

TASK	INTERVAL
Ignition System - Check timing; adjust if needed	Once A Year
Crankcase Oil and Oil Filter - Change	Every 100 Hours of Use or 120 Days - Whichever Occurs First, or Once Yearly
Steering System - Lubricate and inspect for loose, damaged or missing parts	**Saltwater use:** Every 50 hours of operation or 60 days; at least once yearly. **Freshwater use:** Every 100 hours of operation or 120 days; at least once yearly.
Electrical System (Entire) - Check for loose or damaged wiring	**Saltwater use:** Every 50 hours of operation or 60 days; at least once yearly. **Freshwater use:** Every 100 hours of operation or 120 days; at least once yearly.
Cooling System Hoses and Clamps - Inspect for damage and deterioration. Check clamps for tightness.	**Saltwater use:** Every 50 hours of operation or 60 days; at least once yearly. **Freshwater use:** Every 100 hours of operation or 120 days; at least once yearly.
Engine Exhaust System - Inspect for damage, deterioration and restrictions. Check clamps for tightness.	**Saltwater use:** Every 50 hours of operation or 60 days; at least once yearly. **Freshwater use:** Every 100 hours of operation or 120 days; at least once yearly.
Ignition System - Clean and completely inspect condition	Every 100 Hours of Use or 120 Days - Whichever Occurs First, or Once Yearly.
Flame Arrestor and Crankcase Ventilation Hose - Clean and inspect	Every 100 Hours of Use or 120 Days - Whichever Occurs First, or Once Yearly
Continuity Circuit - Check components for loose connections, broken or frayed wires	**Saltwater use:** Every 50 hours of operation or 60 days; at least once yearly. **Freshwater use:** Every 100 hours of operation or 120 days; at least once yearly.
Shift and Throttle Cable and Linkage - Lubricate and inspect for loose, damaged or missing parts	**Saltwater use:** Every 50 hours of operation or 60 days; at least once yearly. **Freshwater use:** Every 100 hours of operation or 120 days; at least once yearly.

MAINTENANCE
(Continued)

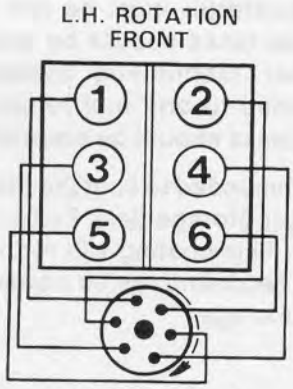
MAINTENANCE CHART
(Continued)

Maintenance Schedule to be Done by Dealer

TASK	INTERVAL
Stern Drive Unit Oil - Change	Every 100 Hours of Use or 120 Days - Whichever Occurs First, or Once Yearly
Transom Gimbal Housing Assembly Swivel Shaft and Gimbal Bearing - Lubricate	**Saltwater use:** Every 50 hours of operation or 60 days; at least once yearly. **Freshwater use:** Every 100 hours of operation or 120 days; at least once yearly.
Engine Coupling, Stern Drive Unit Universal Joint Shaft Splines and Cross Bearings - Lubricate*	Every 100 Hours of Use or 120 Days - Whichever Occurs First, or Once Yearly
Engine Alignment - Check	Every 100 Hours of Use or 120 Days - Whichever Occurs First, or Once Yearly
Fuel Filters - Replace	Once A Year
Steering Head and Remote Control - Inspect and lubricate	Once A Year
Quicksilver MerCathode System - Test output	Once A Year
Closed Cooling Coolant - Test for alkalinity	Once A Year
Heat Exchanger - Clean seawater section	Once A Year
Closed Cooling Coolant - Replace	Every 2 Years
Carburetor - Inspect and adjust	Once A Year

Specifications

MODEL	MCM 185 (229 CID)	MCM 185/175/ 4.3L (262 CID)	MCM 205/ 4.3LX (262 CID)
Horsepower (Kilowatts)	185 (138 kw)	185 (138 kw)	205 (153 kw)
Number of Cylinders	V-6		
Displacement	229 CID (3.8 L)	262 CID (4.3L)	
Bore/ Stroke	3.736 in. (95mm) 3.480 in. (88.4mm)	4.000 in./3.480 in. (101.6mm)/(88.4mm)	
Compression Ratio	8.5:1	9.3:1	
Compression Pressure	155 PSI (1069 kPa)	180 PSI (1241 kPa)	
Idle RPM (In Forward Gear)	650 – 700 RPM		
Max. RPM (at W.O.T.)	4400 – 4800 RPM		
Oil PSI (at 2000 RPM)	30 – 55 PSI (207 – 379 kPa)		
Min. Oil PSI (at Idle)	4 PSI (28 kPa)		
Fuel Pump PSI (at 1000 RPM)	3 – 7 PSI (21 – 48 kPa)		
Electrical System	12-Volt Negative Ground		
Min. Battery Cold Cranking Amps	Min. 450 Amps/90Ah Cold Cranking Amps		
Firing Order	1-6-5-4-3-2		
Spark Plug Type	AC-MR43T/Champion RV15YC4		
Spark Plug Gap	.035 in. (0.9mm)		
Breaker Point Gap	.020 in. (0.51mm)	N/A	
Dwell	34° – 38°	N/A	
Breaker Point Spring Tension	20-27 oz. (567-765 g.)	N/A	
Timing (at Idle RPM)	8° BTDC		
Preliminary Idle Mixture	2 – 3 Turns	1-1/4 Turns	Rochester 2 – 3 Turns Weber 1-1/4 – 1-1/2 Turns
Thermostat	143° F (62° C)		
Crankcase with Filter	4.5 U.S. Quarts (4.3L)		
Standard Cooling System	14 U.S. Quarts (13L)		
Closed Cooling System	20 U.S. Quarts (19L)		



Engine Firing Order

Fuel, Oil, Fluid and Coolant Specifications

FUEL REQUIREMENTS

IMPORTANT: Use of improper gasoline can damage engine seriously. Engine damage resulting from use of improper gasoline is considered misuse of engine, and damage caused thereby will not be covered under the limited warranty.

USA AND CANADA

The use of any good grade unleaded regular or premium gasolines with a minimum posted octane rating of 87 (R + M/2), are satisfactory for use in you engine. In areas where unleaded regular or premium gasolines are not available, a good grade **leaded** regular with a minimum posted octane rating of 89 (R + M/2) may be used. However, gasolines containing alcohol, either methyl alcohol (methanol) or ethyl alcohol (ethanol) may cause increased:

All areas other than USA and Canada should use 92RON rating or higher fuels (leaded or unleaded).

- Corrosion of metal parts.
- Deterioration of elastomer and plastic parts.
- Fuel permeation through flexible fuel lines.
- Wear and damage of internal engine parts.
- Starting and operating difficulties.

Some of these adverse effects are due to the tendency of gasolines containing alcohol to absorb moisture from the air, resulting in a phase of water and alcohol separating from the gasoline in the fuel tank.

The adverse effects of alcohol are more severe with methyl alcohol (methanol) and are worse with increasing alcohol content.

⚠WARNING

FIRE AND EXPLOSION HAZARD: Fuel leakage from any part of the fuel system can be a fire and explosion hazard which can cause serious bodily injury or death. Careful periodic inspection of the entire fuel system is mandatory, particularly after storage. All fuel components including fuel tanks, whether plastic, metal or fiberglass, fuel lines, primer bulbs, fittings, fuel filters and carburetors should be inspected for leakage, softening, hardening, swelling or corrosion. Any sign of leakage or deterioration necessitates replacement before further engine operation.

Because of the possible adverse effects of alcohol in gasoline, it is recommended that only alcohol-free gasoline be used where possible. If only fuel containing alcohol is available, or if the presence of alcohol is unknown, increased inspection frequency for leaks and abnormalities is required.

IMPORTANT: When operating a MerCruiser engine on gasoline containing alcohol, storage of gasoline in the fuel tank for long periods of time should be avoided. Long periods of storage, common to boats, create unique problems. In cars, alcohol-blend fuels normally are consumed before they can absorb enough moisture to cause trouble, but boats often sit idle long enough for phase separation to occur. In addition, internal corrosion may take place during storage if alcohol has washed protective oil films from internal components.

GASOLINE/ALCOHOL BLENDS

Many new motor vehicle owner manuals are warning about the potential damage from using gasoline containing alcohol, especially **METHANOL.** They cite possible fuel system damage and performance problems. These are just two of the hazards that may be caused by alcohol. These same problems as well as the additional safety risk of fire and explosion from fuel system leaks apply to marine engines. **METHANOL** is more severe in its bad effects than is **ETHANOL.** Alcohol also is more severe in older engines, since newer engine components are more resistant to alcohol.

EFFECTS OF GASOLINE/ALCOHOL BLENDS ON MARINE ENGINES

Corrosion of metals may result from use of alcohol-gasoline blends. Portable or permanently installed fuel tanks of metal or fiberglass, fuel filters, fuel lines and float bowls may be affected by alcohol blended fuels. Many fiberglass fuel tanks are slowly dissolved by alcohol, leading immediately to filter and carburetor plugging and eventually to fuel tank failure.

Fuels containing alcohol will absorb moisture from the air. At first, this moisture will remain in solution, but once the water content of the fuel has built up to about one-half of one percent, it will separate out (phase separation), taking the alcohol with it. This alcohol-water mixture settles to the bottom of the fuel tank and if this mixture gets into the engine, the engine can be seriously damaged, internally, as it may wash the protective film of oil off the bore of any cylinder that it enters. Before the engine can be restarted, it is necessary to remove the separated alcohol and water layer, flush out the fuel system with clean fuel, and remove and dry the spark plugs.

BOAT/MOTOR STORAGE

When operating a MerCruiser on gasoline containing alcohol, storage of gasoline in the fuel tank for long periods of time should be avoided.

Long periods of storage, common to boats, create unique problems. In cars, gasoline/alcohol blend fuels normally are consumed before they can absorb enough moisture to cause trouble; but, boats often sit idle long enough for phase separation to occur. In addition, internal corrosion may occur during storage, if alcohol has washed protective oil films from internal components.

COLD WEATHER or EXTENDED STORAGE

If boat is to be placed in cold weather or extended storage, carburetor(s) must be run dry at idle RPM. Permanent fuel tanks should be drained completely, and Quicksilver "Marine Fuel System Treatment and Stabilizer" added to any fuel remaining in the tank. Portable fuel tanks should be emptied completely.

It also is recommended to coat the internal engine parts with Quicksilver Storage Seal. Follow the directions on the container. This coating will reduce possibilities of internal parts becoming rusted from moisture accumulation during storage.

WARRANTY

Performance problems, fuel system or other damage resulting from the use of gasoline-alcohol blended fuels is not the responsibility of Mercury Marine and will not be covered under our warranty.

CONTINUING EVALUATIONS

The effects of gasoline blended with ETHANOL and METHANOL are still being evaluated by the United States Coast Guard, the National Marine Manufacturers Association (NMMA), Mercury Marine, and other engine and boat manufacturers.

We have recommended pump posting of alcohol content of gasoline. Further, we recommend using gasoline known not to contain any METHANOL or ETHANOL, when possible.

TEST FOR ALCOHOL CONTENT IN GASOLINE

The following is an acceptable and widely used field procedure for the detection of alcohol in gasoline. Use any small transparent bottle or tube that can be capped, and is, or can be provided with graduations or a mark at about 1/3 full. A pencil mark on a piece of adhesive tape may be used.

1. Fill the container with water to the mark.
2. Add fuel almost to fill the container, leaving some air space; then, cap the container. The proportions of fuel to water are not critical, but there should be 2-3 times as much fuel as water.
3. Shake container vigorously and allow it to sit upright for up to about 3-5 minutes. **If the volume of water appears to have increased, alcohol is present.** If you are not sure, there is no need for concern. If the dividing line between water and fuel becomes cloudy, use the middle of the cloudy band.

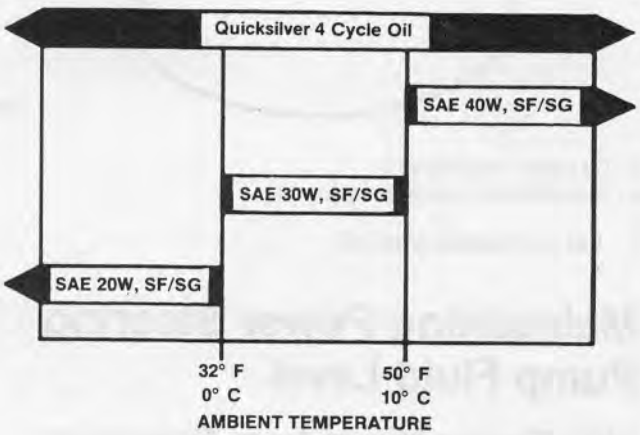
CRANKCASE OIL

To help obtain optimum engine performance and to provide maximum protection, we strongly recommend the use of Quicksilver 4-Cycle Marine Engine Oil. If not available, a good grade, straight weight, detergent automotive oil of correct viscosity, with an API classification of SF or SG, may be used.

The chart below is a guide to crankcase oil selection. Oil filter should always be changed with oil.

In those areas where recommended straight weight oil is not available, a multi-viscosity 20W-40 (SF) or, as a second but less preferable choice, 20W-50 (SF) may be used.

IMPORTANT: The use of non-detergent oils, multi-viscosity oils (other than 20W-40 or 20W-50), low quality oils or oils which contain solid additives specifically are not recommended.



Power Steering Fluid

IMPORTANT: Use only Quicksilver Power Trim and Steering Fluid, or automatic transmission fluid (ATF), Dexron II, in Power Steering System.

Coolant

⚠CAUTION

Alcohol or Methanol base anti-freeze, or plain water, are not recommended for use in fresh water section of cooling system at any time.

We recommend that the coolant section of Closed Cooling System be filled with a 50/50 mixture of ethylene glycol anti-freeze and water. In areas where the possibility of freezing DOES NOT exist, it is permissible to use a solution of rust inhibitor and water (mixed to manufacturer's recommendations).

MerCruiser engines can use any type of permanent anti-freeze or any brand anti-freeze solution that meets G.M. specification 1825M.

Priority Valve, if so equipped

Maintenance inspection is the owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)
Severe Service - Every 25 hrs. of operation or 30 days (whichever comes first)

NOTE: Operation in salt water is considered "Severe Service."

1. Check all connections and hose clamps for adequate tightness. Tighten, if loose.
2. Check all mounting bolts and tighten if necessary.
3. Be sure to check reservoir oil level periodically.

Maintaining Crankcase Oil Level

Overfilled Engine Crankcase

Overfilled crankcases (oil level being too high) can cause a fluctuation or drop in oil pressure and rocker arm "clatter," on MerCruiser engines. The over-full condition results in the engine crankshaft splashing and agitating the oil, causing it to foam (become aerated). The aerated oil causes the hydraulic valve lifters to "bleed down." This, in turn, results in rocker arm "clatter" and loss of engine performance, due to the valves not opening properly.

Care must be taken when checking engine oil level. Oil levell must be maintained between the "ADD" mark and the "FULL" mark on the dipstick. To ensure that you are not getting "false reading," make sure the following steps are done before checking the oil level.

- Boat "at rest" in the water, OR
- If boat is on a trailer, raise or lower bow until the boat is setting at the approximate angle that it would be if setting "at rest" in the water.
- Allow sufficient time for oil to drain into the crankcase if engine has just been run or oil has just been added.

Checking Engine Oil Level/Filling

1. Stop engine and allow boat to come to a rest.
2. Allow oil to drain back into oil pan - approximately 5 minutes.
3. Remove dipstick. Wipe clean and reinstall. Push dipstick all-the-way into dipstick tube.
4. Remove dipstick and note the oil level.
5. Oil level must be between the "FULL" and "ADD" marks.

6. If oil level is below "ADD" mark, proceed to 7 and 8.
7. Remove oil filler cap from valve rocker arm cover.
8. Add required amount of oil to bring level up to, but not over, the "FULL" mark on dipstick.

Changing Oil and Filter

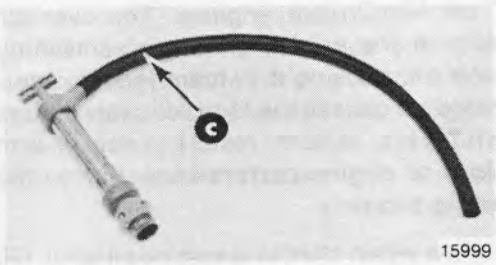
1. Start engine and run until it reaches normal operating temperatures.

IMPORTANT: Change oil when engine is warm from operation, as it flows more freely, carrying away more impurities.

2. Stop engine.
3. Remove drain plug from oil pan.

NOTE: If drain plug is not accessible because of boat construction, oil may be removed thru dipstick tube, using a Quicksilver Crankcase Oil Pump (see "Quicksilver Accessory Guide").

4. After oil has drained completely, reinstall drain plug and tighten securely.



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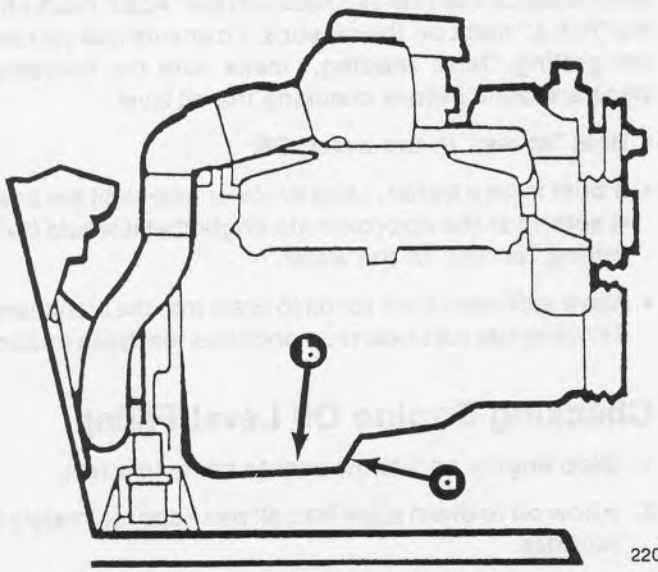

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a - Drain Plug
b - Oil Pan
c - Quicksilver Crankcase Oil Pump

5. Remove and discard oil filter and its sealing ring.
6. Coat sealing ring on new filter with engine oil, and install new filter. Tighten filter securely (following filter manufacturer's instructions). But do not overtighten.

50617

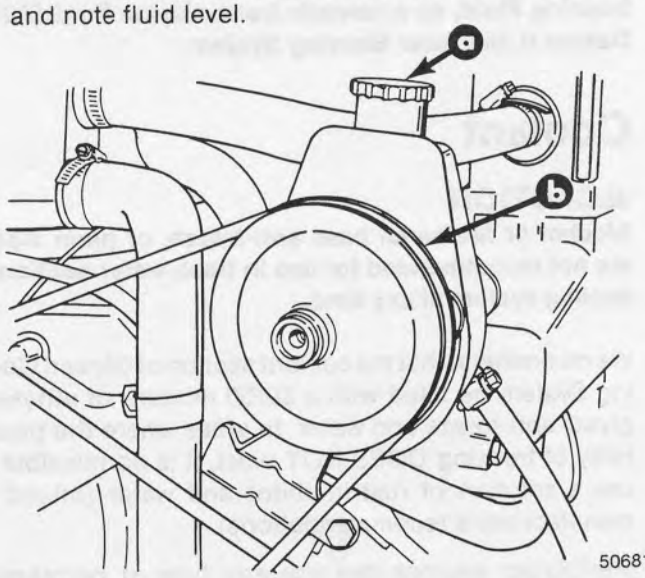
a - Oil Filter - hand tighten
b - Sealing Ring - coat with engine oil

7. Fill crankcase with oil.

Maintaining Power Steering Pump Fluid Level

With Engine Warm from Operation

1. Stop engine and position drive unit so that it is straight back.
2. Remove fill cap/dipstick from Power Steering pump and note fluid level.



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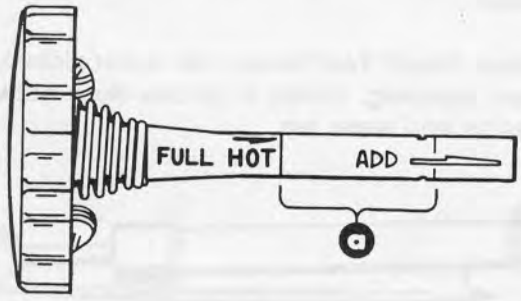
a - Fill Cap/Dipstick
b - Power Steering Pump

3. Level should be between the "FULL HOT" mark and "ADD" mark on dipstick.



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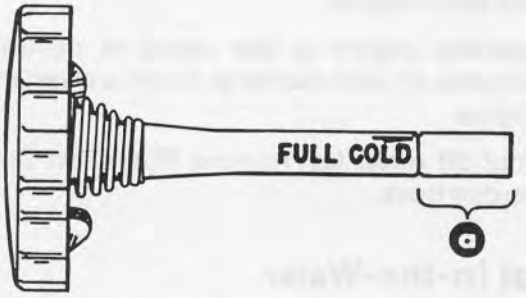
a - Proper Fluid Level with Engine Warm

4. If level is low (below "ADD" mark), but fluid is still visible in pump reservoir, add required amount of fluid thru fill cap opening, to bring level up to "FULL HOT" mark on dipstick - do not overfill.
5. If fluid is not visible in reservoir, a leak exists in Power Steering System.

With Engine Cold

1. Stop engine and position drive unit so that it is straight back.
2. Remove fill cap/dipstick from Power Steering pump and note fluid level.
3. Level should be between "FULL COLD" mark and bottom of dipstick.



22023

a - Proper Fluid Level with Engine Cold

4. If fluid level is below bottom of dipstick, but fluid is still visible in pump reservoir, add required amount of fluid thru fill cap opening, to bring level up to "FULL COLD" mark on dipstick - Do not overfill.
5. If fluid is not visible in reservoir, a leak exists in Power Steering System.

Filling and Bleeding Power Steering System

IMPORTANT: Power Steering system must be filled exactly as explained, following, to be sure that all air is bled from the system. All air must be removed, or fluid in pump may foam during operation and be discharged from pump reservoir. Foamy fluid also may cause Power Steering system to become spongy, which may result in poor boat control.

1. Position drive unit so that it is straight back. Check fluid level with fill cap/dipstick. Add fluid as required, to bring level up to "FULL-COLD" mark on dipstick.

IMPORTANT: Use only Quicksilver Power Trim and Steering Fluid, or Dexron II automatic transmission fluid (ATF), in power steering system.

2. Turn steering wheel back-and-forth to end of travel in each direction several times; then, recheck fluid level and add fluid, if necessary.
3. Install fill cap/dipstick.

⚠CAUTION

DO NOT operate engine without water being supplied to seawater pickup pump in stern drive unit, or pump impeller may be damaged and subsequent overheating damage to engine may result.

4. Start engine and run at fast idle (1000-1500 RPM) until engine reaches normal operating temperature. During this time, turn steering wheel back-and-forth to end of travel in each direction several times.
5. Position drive unit so that it is straight back and stop engine. Remove fill cap from pump. Allow any foam in pump reservoir to disperse; then, check fluid level and add fluid, as required, to bring level up to "FULL-HOT" mark on dipstick. Do not overfill. Reinstall fill cap securely.

IMPORTANT: Drive unit must be positioned straight back and Power Steering fluid must be hot to accurately check fluid level.

6. If fluid is still foamy (in Step 5), repeat Steps 4 and 5 until fluid does not foam and level remains constant.

Maintaining Coolant Level

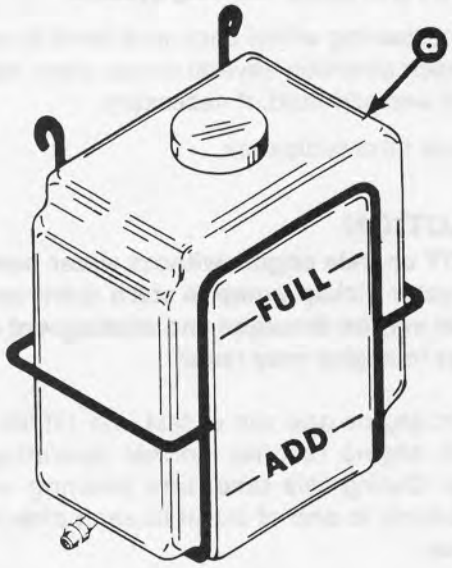
⚠WARNING

Allow engine to cool down before removing pressure cap. Sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly; then, push down and turn cap all-the way off.

1. Coolant level in heat exchanger should be within 1 in. (25mm) from bottom of filler neck.

IMPORTANT: When reinstalling pressure cap, be sure to tighten it until it contacts stop on filler neck.

2. Coolant level should be between the "ADD" and "FULL" mark on coolant recovery reservoir with engine at normal operating temperature.



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a - Coolant Recovery Reservoir

Flushing Cooling System

⚠CAUTION

DO NOT run engine above 1500 RPM when flushing, as suction created by seawater pickup pump in drive unit may collapse garden hose and cause engine and/or drive unit to overheat.

Boat Out-of-Water

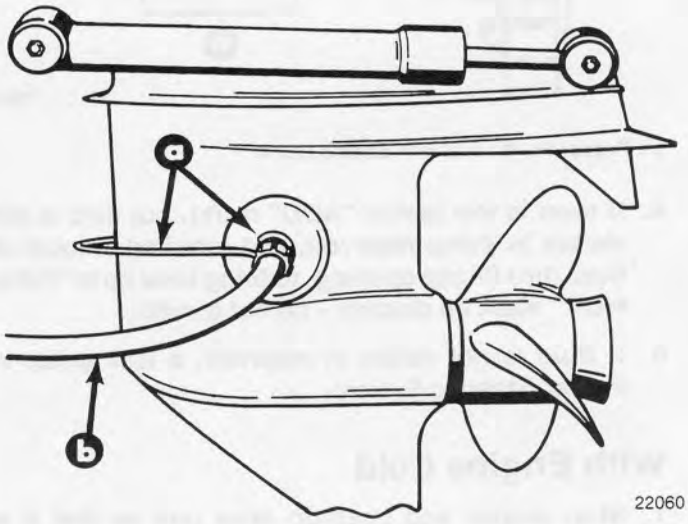
⚠WARNING

When flushing cooling system, be certain that area in vicinity of propeller is clear and that no person(s) is nearby.

⚠WARNING

If engine is to be tested on land, propeller must be removed.

1. Install Flush-Test Device over water pickup holes in gear housing. Attach a garden hose between the device and water tap.



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a - Flush-Test Device
b - Garden Hose - (Do Not Use Full Water Tap Pressure

2. Partially open water tap (approximately 1/2 maximum capacity). Do not use full city water pressure.
3. Place remote control in neutral, idle speed position and start engine.
4. Operate engine at idle speed in neutral for 10 minutes, or until discharge water is clear; then, stop engine.
5. Shut off water tap. Remove Flush-Test Device and garden hose.

Boat In-the-Water

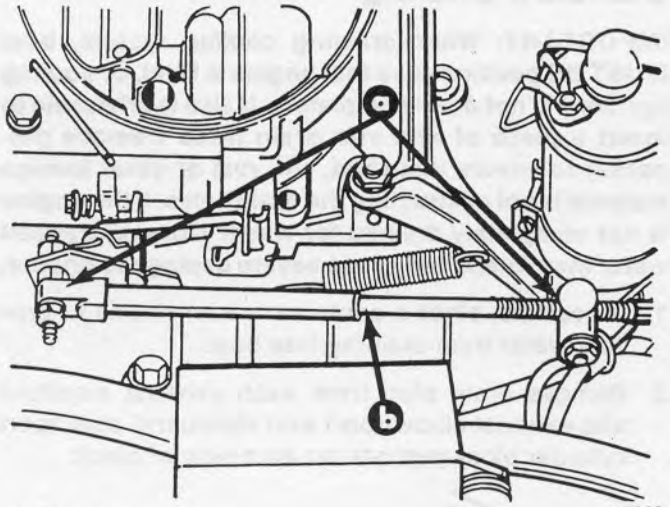
1. Raise drive unit to full "Up" position.
2. Install Flush-Test Device over water pickup holes in gear housing. Attach a garden hose between the device and water tap.
3. Lower drive unit to full "In" position.
4. Follow Steps 2 thru 4 under "Boat Out-of-Water".
5. Shut-off water tap.
6. Raise drive unit to full "Up" position - Remove Flush-Test Device and garden hose.

Lubrication

Throttle and Shift Cable

1. Lubricate pivot points with SAE 30 engine oil.
2. Lubricate cable end guide contact surfaces with Quicksilver 2-4-C Marine Lubricant.

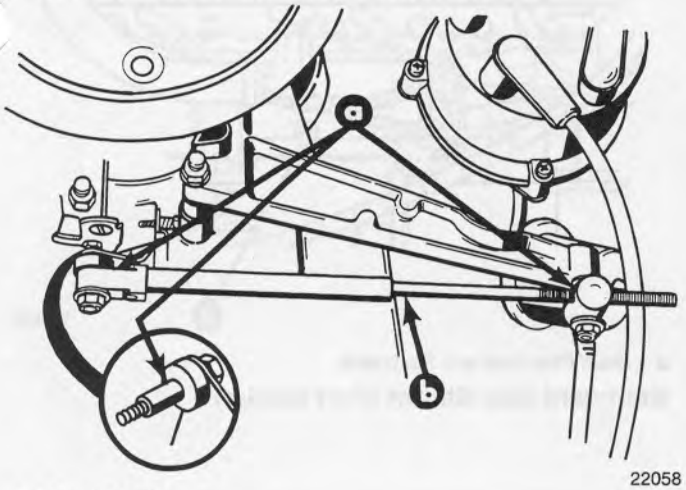
MODELS WITH 4-BARREL CARBURETOR



22062

a - Pivot Points
b - Guide Contact Surface

MODELS WITH 2-BARREL CARBURETOR

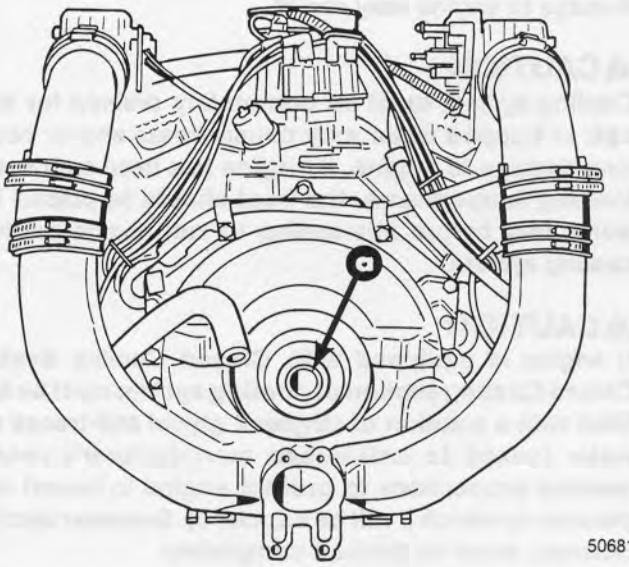


22058

a - Pivot Points
b - Guide Contact Surface

Engine Coupling

1. Lubricate engine coupling splines with Quicksilver Engine Coupler Spline Grease.



50681

a - Engine Coupling Splines — remove cap — lubricate splines

U-Joint Splines

1. Lubricate U-joint shaft splines and O-rings with Quicksilver Engine Coupler Spline Grease. Refer to "MerCruiser Stern Drive Service Manual."

Cold Weather or Extended Storage

Precautions

⚠WARNING

Be careful while working on fuel system; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF" and do not smoke or allow sources of spark and/or open flames in the area.

⚠WARNING

To prevent a potential fire hazard, be sure that engine compartment is well ventilated and that there are no gasoline vapors present during starting or fogging of engine.

⚠CAUTION

DO NOT operate engine without cooling water being supplied to seawater pickup pump, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

⚠CAUTION

Cooling system must be completely drained for storage, or trapped water may cause freeze and/or corrosion damage to engine. If engine has been exposed to freezing temperatures, the boat should be placed in a warm area before attempting to run engine or drain cooling system.

⚠CAUTION

If engine is equipped with Closed Cooling System, Closed Cooling section of cooling system must be kept filled with a solution of ethylene glycol anti-freeze and water (mixed to anti-freeze manufacturer's recommended proportions to protect engine to lowest temperature to which it will be exposed). Seawater section, however, must be drained completely.

⚠CAUTION

A discharged battery can be damaged by freezing.

Layup

NOTICE

Refer to "Precautions", in this section, BEFORE proceeding.

1. Fill fuel tank(s) with fresh gasoline that does not contain alcohol, and add a sufficient amount of Quicksilver "Gasoline Stabilizer and Conditioner" to treat the gasoline.

IMPORTANT: If boat is to be placed in storage (with fuel containing alcohol in fuel tanks), carburetors must be run dry at idle RPM. Fuel tanks should be drained completely and Quicksilver Marine Fuel System Treatment and Stabilizer added to any fuel remaining in the tank. Also, refer to "Fuel Requirements;" see "Index."

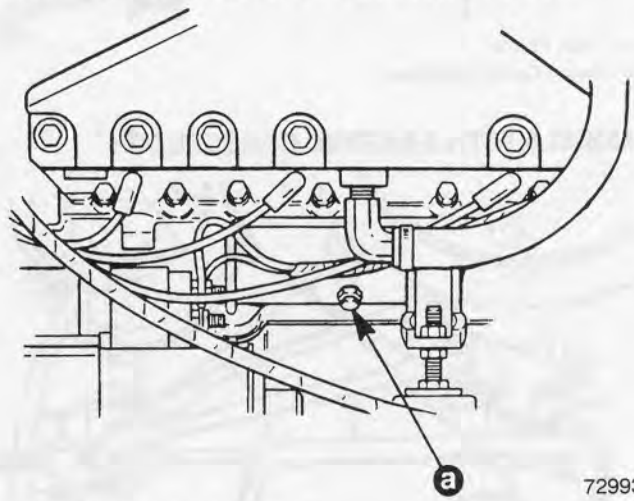
2. Replace all fuel filters.
3. Start engine and check for fuel leaks.
4. Run engine sufficiently to bring it up to normal operating temperature. Shut off engine and change oil and filter.
5. If boat has been operated in salty, polluted or mineral-laden waters, flush cooling system.
6. Remove flame arrestor assembly and restart engine. While operating engine at fast idle (1000-1500 RPM), fog internal surfaces of induction system and combustion chambers by squirting approximately 8 ounces (227 grams) of Quicksilver Storage Seal Rust Inhibitor or SAE 20 SF/SG engine oil into carburetor bores. Stall engine by squirting last 2 ounces (57 grams) of Storage Seal Rust Inhibitor or oil rapidly into carburetor. Turn ignition to "OFF."
7. Close fuel shut off valve, if so equipped.
8. Clean flame arrestor and crankcase ventilation hoses and reinstall.
9. Lubricate all items outlined in "Lubrication."
10. Drain seawater section of cooling system.

Draining Cooling System

Standard Cooling

IMPORTANT: When draining cooling system, boat MUST BE positioned so that engine is level, or cooling system will not drain completely. It also is advisable to insert a piece of wire into drain holes (remove petcocks) to ensure that sand, silt, rust or other foreign material is not obstructing the drain holes. If the engine is not completely drained for winter storage, trapped water may freeze and cause severe damage to engine.

1. If possible, place a container under drains to prevent water from draining into boat.
2. Remove drain plug from each exhaust manifold and exhaust elbow (port and starboard) and open cylinder block petcock on each side of block.



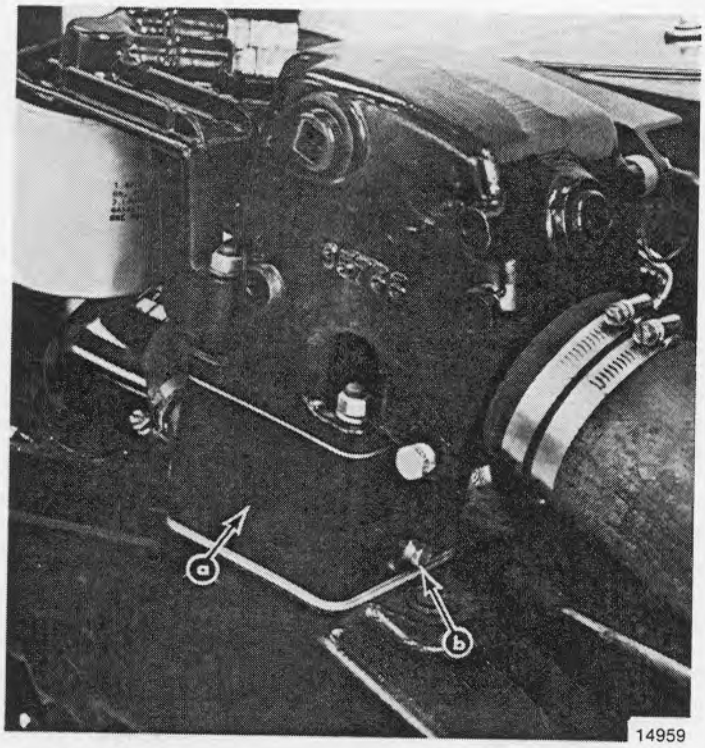
72993

a - Drain Plug (Port and Starboard)

Starboard Side Shown (Port Similar)

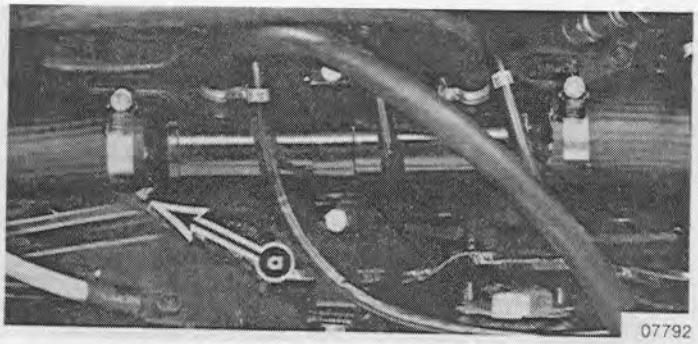
a - Exhaust Elbow Drain Plug (Except Stainless Steel)
b - Exhaust Manifold Drain
c - Cylinder Block Drain

3. If engine is equipped with exhaust elbow risers (located under exhaust elbows) remove drain plug from front of each riser.



a- Exhaust Elbow Riser
b - Drain Plug

4A. **EARLIER STYLE:** On engines equipped with Power Steering, remove drain plug (if equipped) from bottom-aft end of Power Steering oil cooler or remove hose and lower to drain. Later style has no drain plug.

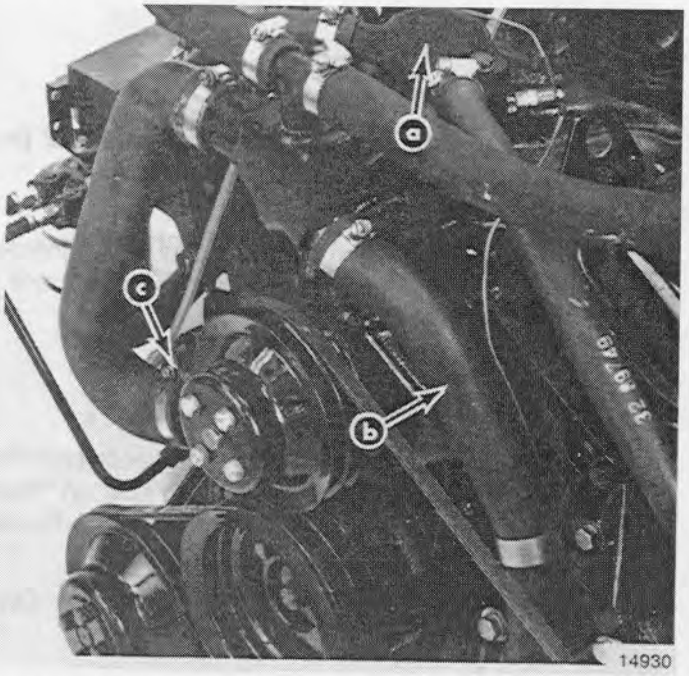


a - Power Steering Oil Cooler Drain Plug (if so Equipped)

4B. **LATER STYLE:** Disconnect hose from aft end of power steering cooler, and bend hose down to allow water to drain.

5. On engines without Power Steering, disconnect water inlet hose from thermostat housing and lower the hose to allow water to drain. Disconnect thermostat housing to circulating pump hose from circulating pump and lower the hose to allow water to drain.

6. After cooling system has drained completely, coat threads of drain plugs with Perfect Seal and reinstall. Close petcocks and reconnect hoses.



a - Thermostat Housing
b - Water Inlet Hose
c - Circulating Pump Hose

11. Closed Cooling System Models, test coolant in closed cooling section to ensure that it will withstand lowest temperature expected during storage.
12. Service batteries.
13. Clean outside of engine and repaint any areas required with Quicksilver Primer and Spray Paint. After paint has dried, spray Quicksilver Corrosion Guard or wipe down with SAE 20 SF/SG engine oil.
14. For Stern Drive Unit, refer to "Stern Drive Manual."

Recommissioning

NOTICE
Refer to "Precautions", in this section, BEFORE proceeding.

1. Check that all cooling system hoses are connected and tight and all petcocks and drain plugs are in and tight.
2. Inspect all drive belts.
3. Check engine alignment.
4. Perform ALL lubrication and maintenance specified for completion "At Least Once Each Year" in "Maintenance Chart," except items which were performed at time of engine layup.
5. Install Stern Drive Unit (refer to "Stern Drive Manual").

⚠CAUTION
When installing battery (in next step), be sure to connect negative (grounded) battery cable to negative (-) battery terminal and positive battery cable to positive (+) terminal. If battery cables are reversed, damage to electrical system WILL result.

6. Install fully-charged battery. Clean battery cable clamps and terminals and reconnect cables. Be sure to tighten clamps securely. Apply a thin coat of petroleum base grease to clamps and terminals to help retard corrosion.
7. Start engine and closely observe instrumentation to ensure that all systems are functioning properly.
8. Carefully inspect entire engine for fuel, oil, water and exhaust leaks.
9. Check fuel pump sight tube.
10. Check steering system and shift and throttle control for proper operation.

TROUBLESHOOTING

1 C

CAUSE	SPECIA
1. Moisture on ignition components	1. Distributor cap or spa
2. Battery, electrical connections, damaged wiring	
3. Ignition switch	
4. Shift interruptor switch	5. Disconnect tachom
5. Shorted tachometer	
6. Ignition timing	7. Fouled, burned, cr
7. Spark plugs	8. Faulty insulation,
8. Spark plug wires	
9. Cracked or dirty distributor cap	10. Check compone
10. Faulty ignition components	11. Synchronizers m (parallel circuit)
11. Engine synchronizer (if equipped) hooked up in series on ignition wire (dual engines only)	

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NOTICE
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PRECAUTIONS

⚠WARNING

Always disconnect battery cables from battery BEFORE working on fuel system to prevent fire or explosion.

⚠WARNING

Be careful when cleaning flame arrestor and crankcase ventilation hose; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF". DO NOT smoke or allow sources of spark or open flame in area when cleaning flame arrestor and crankcase ventilation hose.

⚠WARNING

Be careful when changing fuel system components; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF". DO NOT smoke or allow sources of spark or flame in the area while changing fuel filter. Wipe up any spilled fuel immediately.

⚠WARNING

Make sure no fuel leaks exist, before closing engine hatch.

⚠CAUTION

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

⚠CAUTION

DO NOT operate engine without water being supplied to seawater pickup pump on engine, or pump impeller may be damaged and subsequent overheating damage to engine may result. Engine may be operated with boat out-of-water, if instructions, under "Running Engine with Boat Out-of-the-Water", following, are completed.

⚠WARNING

When running engine with boat out of water, be certain that area in vicinity of propeller is clear and that no person is standing nearby. As a precautionary measure, it is recommended that the propeller be removed.

⚠CAUTION

DO NOT run engine above 1500 RPM, as suction created by seawater pickup pump may collapse water supply hose and cause engine to overheat.

⚠WARNING

Be sure that engine compartment is well ventilated and that no gasoline vapors are present to prevent the possibility of a FIRE.

⚠WARNING

DO NOT leave helm unattended while performing idle speed adjustment.

USED SPARK PLUG ANALYSIS

Use the following illustrations to help reach a decision that plug is or is not serviceable and can be restored by cleaning, filing and regapping. Spark plug condition also can suggest a variety of possible engine malfunctions and, therefore, can indicate needed engine repairs. When old plugs are replaced, entire set should be replaced. Plug service should be performed only those plugs suitable for additional service, using the following procedures:

A. Remove any oil deposits with solvent and dry plugs thoroughly.

B. Open electrode gap wide enough to permit cleaning and filing.

C. Remove combustion deposits from firing end of spark plug with a plug cleaner. Blow off with compressed air to remove abrasives.

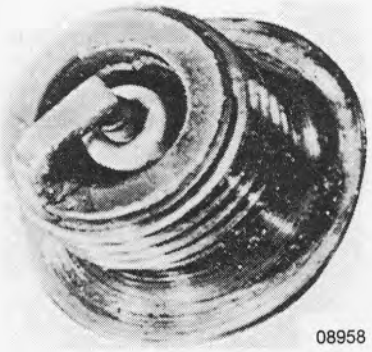
D. File electrode surfaces to restore clean, sharp edges. Again remove filings with compressed air.

E. Reset gap to specifications by bending only side electrode with proper tool.

SPARK PLUG ANALYSIS

NORMAL CONDITION

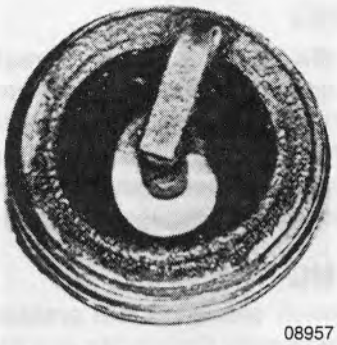
Few deposits are present and probably will be light tan or gray in color. This plug shows that plug heat range is compatible with engine, and engine is electrically and mechanically in good running condition. With proper plug servicing (clean, file and regap), this plug can be reinstalled with good results.



08958

CHIPPED INSULATOR

Chipped insulator usually results from careless plug regapping. Under certain conditions, severe detonation also can split insulator firing ends. Plug must be replaced.



08957

WET FOULING (OIL DEPOSITS)

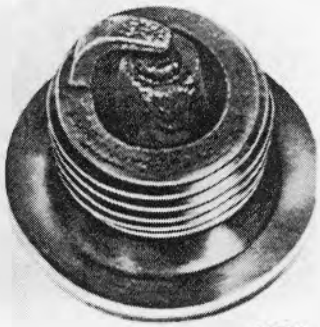
Plug becomes shorted by excessive oil entering combustion chamber, usually in engine with many hours of operation. Worn piston rings, cylinder walls, valve guides or valve stem seals are causes of oil entering combustion chamber. Only engine repairs will permanently relieve oil wet fouling.

IMPORTANT: New engines or recently overhauled engines may wet foul plugs before normal oil control is achieved with proper break-in procedures. Such fouled plugs may be serviced (clean, file and regap) and reinstalled.

08958

COLD FOULING

Dry, black deposits indicate rich fuel mixture or weak ignition. Clogged flame arrestor, flooding carburetor, sticky choke or weak ignition components all are probable causes. If only one or two plugs in set are fouled, however, check for sticking valves or bad ignition leads. After correcting cause, service (clean, file and regap) plugs and reinstall.



08958

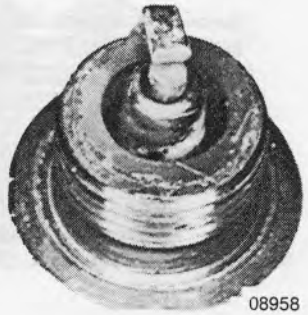
OVERHEATING

Insulator is dull white or gray and appears blistered. Electrodes are eroded and there is an absence of deposits. Check that correct plug heat range is being used. Also check for over-advanced ignition timing, cooling system malfunction, lean fuel/air mixtures, leaking intake manifold or sticking valves. Replace spark plugs.

08957

HIGH SPEED GLAZING

Insulator has yellowish, varnish-like color, indicating that temperatures suddenly have risen, usually during hard, fast acceleration under heavy load. Normal deposits do not get a chance to blow off. Instead, they melt and form a conductive coating. Replace plugs. If condition re-occurs, use colder heat range plug and service plugs more frequently.



08958

SCAVENGER DEPOSITS

Powdery white or yellow deposits are built up on shell, insulator and electrodes. This is normal appearance with certain branded fuels. Accumulation on ground electrode and shell areas may be unusually heavy, but may be easily chipped off. Plugs can be serviced (clean, file and regap) and reinstalled.

08958

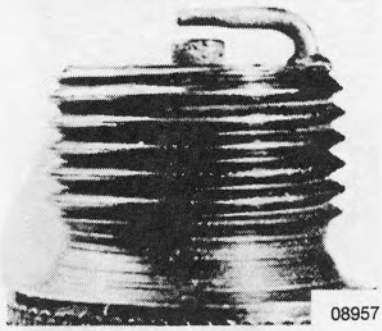
PRE-IGNITION DAMAGE

Pre-ignition damage is caused by excessive high temperatures. Center electrode melts first, followed by ground electrode. Normally, insulators are white but may be dirty if plug has been misfiring. Check for correct plug heat range, advanced ignition timing, lean fuel mixture, incorrect fuel used, malfunctioning cooling system, leaking intake manifold or lack of lubrication.

08957

REVERSED COIL POLARITY

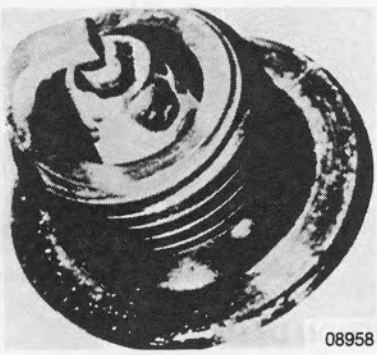
Concave erosion of ground electrode is an indication of reversed polarity. Center electrode will show only normal wear. Engine will misfire and idle rough. To correct, reverse primary coil leads. Replace spark plugs.



08957

SPLASHED DEPOSITS

Spotted deposits, which sometimes occur after long delayed tune-up, accumulate after a long period of misfiring. When normal combustion temperatures are restored, upon installation of new plugs, deposits loosen from top of piston and head and are thrown against hot insulator. Clean and service plugs and reinstall.



08958

MECHANICAL DAMAGE

Mechanical damage to spark plug firing end is caused by foreign object in combustion chamber. Because of valve overlap, small objects can travel from one cylinder to another. Check all cylinders, intake manifold and exhaust manifold to prevent further damage.

08957

IMPORTANT: When working on engine, spark plug holes and carburetor throat should be kept covered to prevent foreign objects from entering combustion chamber.

POOR BOAT PERFORMANCE and/or POOR MANEUVERABILITY

SYMPTOM	CAUSE
1. Bow too low	1. A. Improper drive unit trim angle B. Improper weight distribution C. Boat is underpowered D. Permanent or power hook in boat bottom E. False bottom full of water F. Improperly adjusted trim tabs (after planes)
2. Bow too high	2. A. Improper drive unit trim angle B. Propeller pitch too great C. Dirty boat bottom (marine growth) D. Poor running engine E. Improper weight distribution F. Rocker in boat bottom G. False bottom full of water H. Improperly adjusted trim tabs (after planes)
3. Propeller ventilating	3. A. Drive unit installed too high on transom B. Dirty or rough boat bottom C. Damaged propeller, pitch too small, diameter too small D. Keel located too close to propeller or too deep in the water E. Water pick-up or accessories located too close to propeller F. Hook in boat bottom G. Propeller plugged up with weeds

IMPROPER FULL THROTTLE ENGINE RPM

RPM TOO HIGH

CAUSE	SPECIAL INFORMATION
1. Propeller	1. Damaged, pitch too low, diameter too small propeller hub slipping.
2. Boat	2. Water pick-up or accessories mounted too close to propeller (ventilation), keel located too close to propeller and/or too deep in the water (ventilation). Drive installed too high on transom, wrong gear ratio.
3. Operation	3. Unit trimmed out too far.
4. Engine coupler slipping	

RPM TOO LOW

CAUSE	SPECIAL INFORMATION
1. Propeller	1. Damaged, pitch too great, diameter too great.
2. Boat	2. Dirty or damaged bottom, permanent or power hook in bottom, false bottom full of water. Drive installed too low on transom, wrong gear ratio.
3. Operation	3. Unit trimmed in too far.

ENGINE CRANKS OVER BUT WILL NOT START OR STARTS HARD

IMPORTANT INFORMATION

1. The first thing that must be determined is which system on the engine is causing the problem. To make an engine run basic components - fuel, spark (ignition), and compression are required. If all three components are present, the engine should run. If any one of the three are missing, weak, or arriving at the wrong time the engine will not run.
2. Determine if there is fuel present by looking down carburetor venturi while actuating throttle. There should be a stream of fuel coming out of the accelerator pump nozzles if the carburetor has fuel.
3. Check ignition system operation. Remove coil wire from tower on distributor cap. Hold coil wire near ground and check for spark while cranking engine over. Repeat procedure with spark plug wires. If there is spark at the spark plug wires, remove the spark plugs and make sure the plugs are correct type and heat range, and not fouled or burned.
4. Run a compression check on engine to make sure the engine is mechanically OK.

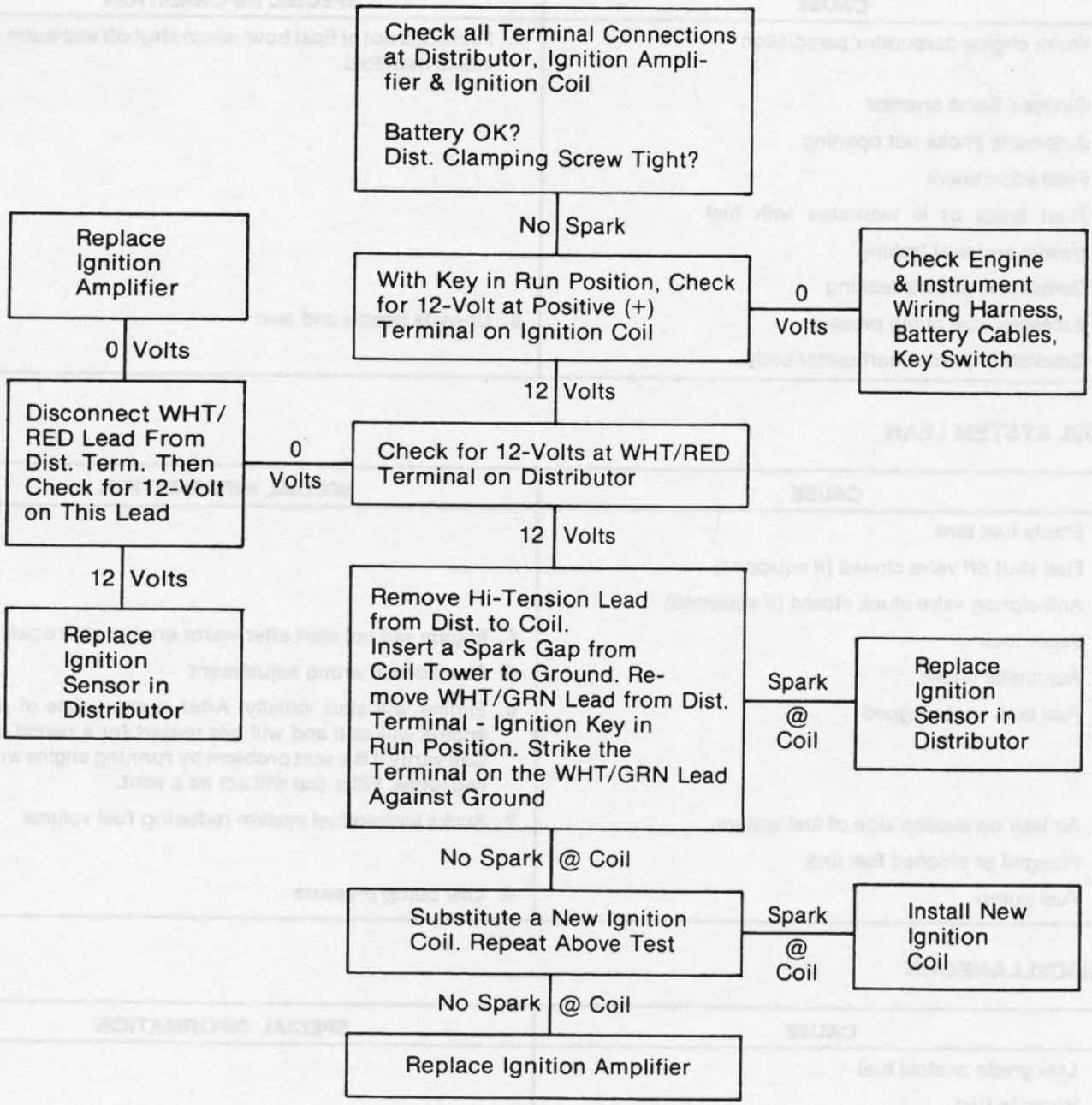
CONVENTIONAL IGNITION (NO SPARK)

CAUSE	SPECIAL INFORMATION
1. Moisture on ignition components	1. Distributor cap or spark plug leads arcing
2. Battery, electrical connections, damaged wiring	
3. Ignition switch	3. May run in start position and loose spark in the run position
4. Shift interruptor switch	
5. Shorted tachometer	5. Disconnect tachometer and try again.
6. Ignition timing	6. May crank over hard, backfire, or try to run backwards
7. Faulty ignition resistor wire or bypass wire	
8. Ignition points improperly gapped, burned or dirty	
9. Spark plugs	9. Fouled, burned, cracked porcelain
10. Spark plug wires	10. Faulty insulation, broken wires
11. Cracked or dirty distributor cap or rotor	
12. Coil	
13. Condenser	

THUNDERBOLT IV (HEI) IGNITION (NO SPARK)

CAUSE	SPECIAL INFORMATION
1. Moisture on ignition components	1. Distributor cap or spark plug wires arcing
2. Battery, electrical connections, damaged wiring	
3. Ignition switch	
4. Shift interruptor switch	
5. Shorted tachometer	5. Disconnect tachometer and try again
6. Ignition timing	
7. Spark plugs	7. Fouled, burned, cracked porcelain
8. Spark plug wires	8. Faulty insulation, broken wires
9. Cracked or dirty distributor cap	
10. Faulty ignition components	10. Check components
11. Engine synchronizer (if equipped) hooked up in series on purple ignition wire (dual engines only)	11. Synchronizers must be hooked up directly at coil terminal (parallel circuit)

THUNDERBOLT IV (HEI) IGNITION TEST



FUEL SYSTEM RICH

CAUSE	SPECIAL INFORMATION
1. Warm engine carburetor percolation	1. Fuel boils out of float bowl when shut off and warm. Flood intake manifold.
2. Clogged flame arrestor	
3. Automatic choke not opening	
4. Float adjustment	
5. Float leaks or is saturated with fuel	
6. Needle and seat leaking	
7. Carburetor gaskets leaking	
8. Excessive fuel pump pressure	8. Unseats needle and seat
9. Cracked or porous carburetor body	

FUEL SYSTEM LEAN

CAUSE	SPECIAL INFORMATION
1. Empty fuel tank	
2. Fuel shut off valve closed (if equipped)	
3. Anti-siphon valve stuck closed (if equipped)	
4. Vapor lock	4. Engine will not start after warm engine shut down
5. Automatic choke	5. Stuck open, wrong adjustment
6. Fuel tank vent plugged	6. Engine will start initially. After a short time of running engine will stall and will not restart for a period of time. Can varify it is a vent problem by running engine with filler cap loose. Filler cap will act as a vent.
7. Air leak on suction side of fuel system	7. Sucks air into fuel system reducing fuel volume
8. Plugged or pinched fuel line	
9. Fuel pump	9. Low pump pressure

MISCELLANEOUS

CAUSE	SPECIAL INFORMATION
1. Low grade or stale fuel	
2. Water in fuel	
3. Vacuum leak	
4. Low compression	4. Worn valves, rings, cylinder, or head gasket
5. Valve timing incorrect	5. Timing chain or gears jumped or improperly installed

ENGINE WILL NOT CRANK OVER

CAUSE	SPECIAL INFORMATION
1. Control lever not in neutral position	
2. Battery charge low, damaged wiring, loose electrical connections	
3. Blown fuse at starter motor	3. Early models with red wire going to fuse on starter terminal
4. Circuit breaker tripped	
5. Ignition switch	
6. Slave solenoid	
7. Faulty neutral start safety switch	7. Open circuit
8. Starter solenoid	
9. Starter motor	

CHARGING SYSTEM INOPERATIVE

CAUSE	SPECIAL INFORMATION
1. Loose or broken drive belt	
2. Engine RPM too low on initial start	2. Rev engine to 1500 RPM
3. Loose or corroded electrical connections	
4. Faulty ammeter or battery gauge	4. Best way to test is to replace gauge
5. Battery will not accept charge	5. Low electrolyte, failed battery
6. Faulty alternator or regulator	
7. Failed fuse (if so equipped)	7. Fuse located on starter terminal stud. Orange output wire from alternator connects to fuse.
8. Refer to "Section 4 Part C" for complete Charging System troubleshooting procedures.	

NOISY ALTERNATOR

CAUSE	SPECIAL INFORMATION
1. Loose mounting bolts	
2. Drive belt	2. Worn, frayed, loose
3. Loose drive pulley	
4. Worn or dirty bearings	
5. Faulty diode trio or stator	

INSTRUMENTATION MALFUNCTION

CAUSE	SPECIAL INFORMATION
1. Faulty wiring, loose or corroded terminals	
2. Bad key switch	2. Test as outlined in "Section 4, Part D"
3. Faulty gauge	3. Test as outlined in "Section 4, Part D"
4. Faulty sender	4. Test as outlined in "Section 4, Part D"

RADIO NOISE

CAUSE	SPECIAL INFORMATION
1. A "popping" noise that will increase with engine RPM. Noise will stop as soon as engine is turned off.	1. Ignition System - wrong spark plugs, cracked distributor cap, cracked coil tower, leaking spark plug wires, moisture on ignition components.
2. "High pitched whine" in the radio	2. Alternator - poor brush contact on the slip rings
3. A "hissing or crackling" noise when instruments are jarred with ignition on	3. Instrumentation - loose connections, or antennae wire routed too close to instruments
4. Varying unexplained noises	4. Accessories - bilge pump, bilge blower, fish finder, depth locator, cabin heater motor, etc. Disconnect one at a time until noise disappears.

POOR FUEL ECONOMY

CAUSE	SPECIAL INFORMATION
1. Fuel leaks	
2. Operator habits	2. Prolonged idling, slow acceleration, failure to cut back on throttle once boat is on plane, boat overloaded, uneven weight distribution
3. Engine laboring	3. Bent, damaged, wrong propeller. Water test boat for proper operating RPM at WOT.
4. Clogged flame arrestor	
5. Engine compartments sealed too tight	
6. Boat bottom	6. Dirty (marine growth), hook, rocker
7. Carburetor	7. Idle mixture settings, accelerator pump adjustment, linkage binding, choke adjustment, carburetor flooding over, main fuel jets
8. Improper fuel	
9. Crankcase ventilation system not working	
10. Engine needs tune-up	
11. Engine running too cold or too hot	
12. Plugged or restricted exhaust	
13. Engine	13. Low on compression

CARBURETOR MALFUNCTIONS

SYMPTOM	CAUSE
1. Flooding	1. A. Needle and seat B. Float adjustment C. Saturated float D. Gaskets leaking E. Cracked fuel bowl F. Fuel percolation G. Automatic choke
2. Rough idle	2. A. Idle RPM too low B. Idle mixture screws C. Idle passages dirty D. Throttle valves not closing E. Engine flooding F. Vacuum leak G. Throttle body heat passages plugged
3. Hesitation or acceleration flatness	3. A. Accelerator pump B. Leaking gaskets C. Automatic choke D. Power piston or power valve E. Throttle valves F. Throttle body heat passages plugged G. Main metering jets H. Float adjustment I. Secondary air valve wind-up
4. Engine surges	4. A. Main metering jets B. Leaking gaskets C. Float adjustment D. Saturated float E. Power piston or valve F. Throttle valves
5. Low top speed or lack of power	5. A. Power piston or valve B. Float adjustment C. Main metering jets D. Leaking gaskets
6. Poor cold engine operation	6. A. Idle RPM too low B. Idle mixture screws C. Throttle valves D. Automatic choke E. Engine flooding
7. Engine stalls	7. A. Idle RPM too low B. Idle mixture screws C. Engine flooding D. Automatic choke E. Dirt in carburetor F. Accelerator pump G. Leaking gaskets
8. Hard starting	8. Refer to "Engine Starts Hard"

ENGINE RUNS POORLY AT IDLE

CAUSE	SPECIAL INFORMATION
1. Clogged flame arrestor	
2. Improper idle fuel mixture adjustment	
3. Moisture on ignition components	3. Cap or spark plug wires arcing
4. Water in fuel	
5. Low grade or stale fuel	
6. Incorrect ignition timing	
7. Automatic choke	
8. Spark plugs	8. Fouled, burned, cracked porcelain
9. Incorrect point gap, burned or pitted points	
10. Spark plug wires	10. Insulation break down, wires broken
11. Defective coil or condenser	
12. Cracked or dirty distributor cap	
13. Incorrect float level	
14. Dirty carburetor	
15. Vacuum leak	15. Leak at manifold or carburetor base
16. Incorrect fuel pump pressure	16. Too low, can't supply the carburetor Too high, unseats the needle and seat
17. Low compression	17. Also check for blown head gasket
18. Loose or worn distributor	18. Timing and/or dwell changes
19. Water leaking into cylinders	19. Head gasket, exhaust manifold, cracked head or valve seat
20. Loose or broken engine mounts	

ENGINE ACCELERATION IS POOR

CAUSE	SPECIAL INFORMATION
1. Also refer to poor boat performance	
2. Idle mixture screws	
3. Air valve spring out of adjustment	3. Rochester 4 barrel carb only
4. Incorrect ignition timing	
5. Incorrect distributor or amplifier advance curve	5. Refer to Section 4, Part B
6. Accelerator pump	6. Check for stream of raw fuel from accelerator pump discharge nozzle, when opening throttle with engine shut off
7. Cracked or dirty distributor cap or rotor	
8. Vacuum leak	8. Manifold or carburetor base
9. Spark plugs	9. Fouled, burned, wrong heat range, cracked porcelain
10. Incorrect point gap, dirty or burned points	
11. Float adjustment	
12. Dirty carburetor	
13. Low compression	

ENGINE RUNS POORLY AT HIGH RPM

CAUSE	SPECIAL INFORMATION
1. Also refer to poor boat performance	
2. Crankcase over-filled with oil	2. Check oil level with boat at rest in the water. Refer to Section 1, Part B
3. Anti-siphon valve (if equipped)	3. Restricting fuel supply
4. Plugged fuel tank vent	
5. Fuel supply	5. Refer to carburetor malfunctions
6. Ignition timing	
7. Low grade of fuel or water in the fuel	
8. Spark plugs	8. Fouled, burned, cracked, porcelain, heat range
9. Spark plug wires	9. Poor insulation, broken wires
10. Distributor cap or rotor	10. Dirty or cracked
11. Coil	
12. Distributor	12. Points, condenser, worn cam, excessive play in shaft
13. Engine overheating	13. Refer to engine over heats
14. Low compression	14. Worn valves, rings, cylinders, etc.
15. Restricted exhaust	

TROUBLESHOOTING WITH VACUUM GAUGE

READING	CAUSE
1. Steady reading betweeen 15-21 inches at idle RPM	1. Normal
2. Extremely low reading, but steady at idle RPM	2. Vacuum leak, incorrect timing, under powered boat, faulty boat bottom
3. Fluctuates between high and low at idle RPM	3. Blown head gasket between 2 adjacent cylinders
4. Fluctuates 4 or 5 inches very slowly at idle RPM	4. Carburetor needs adjustment, spark plug gap too narrow, valves are sticking
5. Fluctuates rapidly at idle, steadies as RPM is increased	5. Valve guides are worn
6. Continuously fluctuates between low and normal reading at regular intervals at idle RPM	6. Burned or leaking valve

ENGINE NOISE

IMPORTANT INFORMATION

No definite rule or test will positively determine source of engine noise; therefore, the following information should be used only as a general guide to engine noise diagnosis.

1. Use a timing light to determine if noise is timed with engine speed or one-half engine speed. Noises timed with engine speed, are related to crankshaft, rods, pistons, piston pins, and flywheel. Noises timed to one-half engine speed are valve train related.
2. The use of a stethoscope can aid in locating a noise source; however, because noise will travel to other metal parts not involved in the problem, caution must be exercised.
3. If you believe noise is confined to one particular cylinder, ground spark plug leads, one at a time. If noise lessens noticeably or disappears, it is isolated to that particular cylinder.
4. Try to isolate the noise to location in engine. Front to back, top to bottom. This can help determine which components are at fault.
5. Sometimes noises can be caused by moving parts coming in contact with other components. Examples of this would be, flywheel or coupler, exhaust flappers rattling against exhaust pipe, crankshaft striking (pan, pan baffle, or dipstick tube), rocker arm striking valve cover, and loose flywheel cover. In many cases if this is found to be the problem a complete engine tear down is not necessary.
6. When noise is isolated to a certain area and component, removal and inspection will be required. Refer to proper sections of service manual for information required for service.
7. If noise cannot be distinguished between engine or drive unit, remove drive from boat. Run a water supply directly to engine. Run engine without the drive to determine if noise is still there.

VALVE COVER AREA

LOCATION	POSSIBLE CAUSES
1. Valve cover area, timed to one-half engine speed, noise could be confined to one cylinder or may be found in any multitude of cylinders.	1. A. Rocker arm striking valve cover B. Rocker arm out of adjustment C. Worn rocker arm D. Bent push rod E. Collapsed lifter

CYLINDER AREA

LOCATION	POSSIBLE CAUSES
1. Cylinder area, may be confined to one cylinder or found in more than one cylinder, timed to engine speed	1. A. Sticking valve B. Carbon build up C. Connecting rod installed wrong D. Bent connecting rod E. Piston F. Piston rings G. Piston pin H. Cylinder worn

CAMSHAFT AREA

LOCATION	POSSIBLE CAUSES
1. Camshaft area, front of engine, timed to one-half engine speed	1. A. Camshaft timing sprocket or gear B. Timing chain C. Fuel pump D. Valve lifter E. Cam bearings
2. Camshaft area, center of engine, timed to one-half engine speed	2. A. Fuel pump B. Valve lifter C. Cam bearings
3. Camshaft area, rear of engine, timed to one-half engine speed	3. A. Distributor gear B. Valve lifter C. Cam bearings
4. Camshaft area, throughout engine, timed to one-half engine speed	4. A. Loss of oil pressure B. Valve lifters C. Cam bearings

CRANKSHAFT AREA

LOCATION	POSSIBLE CAUSES
1. Crankshaft area, front of engine, timed to engine speed	1. A. Crankshaft timing sprocket or gear B. Timing chain C. Main bearing D. Rod bearing
2. Crankshaft area, center of engine, timed to engine speed	2. A. Crankshaft striking pan or pan baffle B. Main bearing C. Rod bearing
3. Crankshaft area, rear of engine, timed to engine speed	3. A. Loose flywheel cover B. Loose coupler C. Loose flywheel D. Drive plate E. Main bearing F. Rod bearing
4. Crankshaft area, throughout engine, timed to engine speed	4. A. Loss of oil pressure B. Main bearings C. Rod bearings

MISCELLANEOUS

NOISE	POSSIBLE CAUSE
1. Engine spark knock	1. A. Advanced timing B. Low octane fuel C. Engine running hot D. Carbon deposits in engine
2. Popping through carburetor	2. A. Wrong ignition timing B. Carburetor set up too lean C. Faulty accelerator pump D. Vacuum leak E. Valve adjustment F. Valve timing G. Burned or stuck valve
3. Hissing	3. A. Vacuum leak B. Fuel pump (hissing in sight tube) C. Leaking exhaust (manifolds or pipes) D. Loose cylinder heads E. Blown head gasket
4. Whistle	4. A. Vacuum leak B. Dry or tight bearing in an accessory
5. Sparks jumping	5. A. Leaking high tension lead B. Cracked coil tower C. Cracked distributor cap
6. Squeaks or squeals	6. A. Drive belt slipping B. Dry or tight bearing in an accessory C. Parts rubbing together
7. Rattling in exhaust pipe area	7. A. Exhaust shutters

OIL PRESSURE

IMPORTANT INFORMATION

NOTICE
Refer to "Section 1, Part B" for minimum oil pressure readings.

CAUSE	SPECIAL INFORMATION
1. Measuring oil pressure	1. Use a good automotive oil pressure test gauge. Do not rely on the oil pressure gauge in the boat.
2. Check engine oil level with boat at rest in the water	2. Oil level should be between the add and full marks
3. Oil level in crankcase above full mark	3. May cause loss of engine RPM, oil pressure gauge flucuation, drop in oil pressure, and hydraulic valve lifter noise at high RPM
4. Oil level in crankcase below add mark	4. Low oil pressure, oil pressure gauge flucuation, internal engine noise and/or damage
5. Change in oil pressure	5. This may be a normal condition. Oil pressure may read high in the cooler times of the day, and when engine is not up to operating temperature. As the air temperature warms up and engine is running at normal operating temperature, it is normal for oil pressure to drop off slightly.
6. Low engine oil pressure at idle	6. With modern engines and engine oils, low oil pressure readings at idle does not necessarily mean there is a problem. If valve lifters do not "clatter" (at idle), there is a sufficient volume of oil to lubricate all internal moving parts properly. The reason for the drop in oil pressure is that engine heat causes an expansion of the internal tolerances in the engine and also the oil will thin out somewhat from heat.
7. Low engine oil pressure at idle after running at a high RPM	7. Refer to "No. 5 and 6" preceding
8. Boats with dual engines	8. It is not uncommon to see different oil pressure readings between the two engines, as long as both engines fall within specifications. Differences in oil pressure can be attributed to differences in engine tolerances, gauges, wiring, senders, etc.
9. Boats with dual stations	9. Refer to "No. 8" preceding

LOW OIL PRESSURE

NOTICE
Refer to "Section 1, Part B" for minimum oil pressure readings.

CAUSE	SPECIAL INFORMATION
1. Low oil level in crankcase	
2. Defective oil pressure gauge and/or sender	2. Verify reading with an automotive test gauge. Refer to "Section 4, Part D" for instrument testing.
3. Thin or diluted oil	3. Oil broken down, contains water or gas, wrong viscosity, engine running too hot or too cold, excessive idling in cold water (condensation)
4. Oil pump	4. Relief valve stuck open, pick-up tube restricted, worn parts in oil pump, air leak on suction side of oil pump or pick-up tube
5. Oil leak, can be internal or external	5. Oil passage plugs leaking, cracked or porous cylinder block
6. Excessive bearing clearance	6. Cam bearings, main bearings, rod bearings

HIGH OIL PRESSURE

CAUSE	SPECIAL INFORMATION
1. Oil too thick	1. Wrong viscosity, oil full of sludge or tar
2. Defective oil pressure gauge and/or sender	2. Verify with an automotive test gauge **IMPORTANT: Oil pressure slightly higher than normal does not always mean there is a problem. Tolerance stack-up in the engine, oil viscosity, and weather conditions could cause high oil pressure.**
3. Clogged or restricted oil passage	
4. Oil pump relief valve stuck closed	

EXCESSIVE OIL CONSUMPTION

CAUSE	SPECIAL INFORMATION
1. Normal consumption	1. One quart of oil consumed in 5-15 hours of operation at WOT (especially in a new or rebuilt engine) is normal
2. Oil leaks	2. Clean bilge, run engine with clean white paper on bilge floor, locate oil leak(s)
3. Oil too thin	3. Oil diluted or wrong viscosity
4. Oil level too high	
5. Drain holes in cylinder head plugged	5. Oil will flood valve guides
6. Defective valve seals	
7. Intake manifold gasket leaking	
8. Worn valve stems or valve guides	
9. Defective oil cooler (if so equipped)	9. Crack in cooler tubes
10. Defective piston rings	10. Glazed, scuffed, worn, stuck, improperly installed, ring grooves worn, improper break-in, wrong end gap
11. Defective cylinders	11. Out of round, scored, tapered, glazed, excessive piston to cylinder clearance, cracked piston
12. Excessive bearing clearance	

WATER IN ENGINE

IMPORTANT INFORMATION

IMPORTANT: The first thing that must be determined is where in the engine the water is located. This information can be of great help when trying to determine where the water came from and how it got into the engine. The three most common problems are "water on top of pistons, water in crankcase oil and on top of pistons".

The first step, after the water is located, is to remove all the water from the engine by removing all spark plugs and pump cylinders out by cranking engine over. Next change oil and filter. Now start engine and see if the problem can be duplicated. If problem can be duplicated there more than likely is a mechanical problem of some sort. If the problem cannot be duplicated the problem is either an operator error or a problem that exists only under certain environmental conditions.

If water is contained to cylinder(s) only, it is usually entering through the intake system, exhaust system, or head gasket.

If the water is contained to crankcase only, it is usually caused by a cracked or porous block, a flooded bilge, or condensation.

If the water is located in both the cylinder(s) and the crankcase, it is usually caused by water in the cylinders getting past the rings and valves, or complete submersion.

Checking for rust in the intake manifold or exhaust manifolds is a good idea. Rust in these areas will give clues if the water entered through these areas.

WATER ON TOP OF PISTONS

CAUSE	SPECIAL INFORMATION
1. Operator shut engine off at high RPM	
2. Engine "diesels" or trys to run backwards	2. Engine out of tune, poor fuel, high idle RPM, timing set too high
3. Rain water running into flame arrestor	3. Hatch cover
4. Spark plug misfiring	4. Improper combustion causes moisture in the air to accumulate in the cylinder
5. Backwash through the exhaust system	
6. Improper engine or exhaust hose installation	6. Refer to Section 6, Part C for exhaust specifications
7. Cracked exhaust manifold	
8. Improper manifold to elbow gasket installation	
9. Loose cylinder head bolts	
10. Blown cylinder head gasket	10. Check for warped cylinder head or cylinder block
11. Cracked valve seat	
12. Porous or cracked casting	12. Check cylinder heads, cylinder block, and intake manifold

WATER IN CRANKCASE OIL

CAUSE	SYMPTOM
1. Water in boat bilge	1. Boat has been submerged or bilge water was high enough to run in through dipstick tube.
2. Water seeping past piston rings or valves	2. Refer to water in engine (on top on pistons)
3. Engine running cold	3. Defective thermostat, missing thermostat, prolonged idling in cold water
4. Intake manifold leaking near a water passage	
5. Cracked or porous casting	5. Check cylinder head, cylinder block, and intake manifold

ENGINE OVERHEATS (MECHANICAL)

CAUSE	SPECIAL INFORMATION
1. Engine RPM below recommendations at WOT (engine laboring)	1. Damage or wrong propeller, growth on boat bottom, false bottom full of water
2. Wrong ignition timing	2. Timing too far advanced
3. Sticking distributor advance weights	
4. Spark plug wires crossed (wrong firing order)	
5. Lean fuel mixture	5. Refer to carburetor malfunctions in this section
6. Wrong heat range spark plugs	
7. Exhaust restriction	
8. Valve timing off	8. Jumped timing chain and/or gears or improperly installed
9. Blown head gasket(s)	9. A blown head gasket(s) normally cannot be detected by a compression check. Normally the engine will run at normal temperature at low RPM, but will overheat at speeds above 3000 RPM. **Engines that are seawater cooled:** Using a clear plastic hose look for air bubbles between seawater pump and engine. If there are no bubbles present, install clear plastic hose between thermostat housing and manifold(s). If air bubbles are present at a higher RPM it is a good indication there is a blown head gasket. Refer to Section 6, Part A.
10. Insufficient lubrication to moving parts of engine	10. Defective oil pump, plugged oil passage, low oil level

ENGINE OVERHEATS (COOLING SYSTEM)

CAUSE	SPECIAL INFORMATION
IMPORTANT: The first step is to verify if the engine is actually overheating or the temperature gauge or sender is faulty.	**IMPORTANT: Best way to test gauge or sender is to replace them.**
1. Loose or broken drive belt	
2. Seawater shut-off valve partially or fully closed (if equipped)	
3. Clogged or improperly installed sea strainer	
4. Loose hose connections between seawater pick-up and seawater pump inlet. (Models with belt driven seawater pump only)	4. Pump will suck air. Pump may fail to prime or will force air bubbles into cooling system.
5. Seawater inlet hose kinked or collapsed	
6. Seawater pick-up clogged	
7. Obstruction on boat bottom causing water turbulence	7. Obstruction will be in front of seawater pick-up, causing air bubbles to be forced into cooling system.
8. Defective thermostat	
9. Exhaust elbow water outlet holes plugged	
10. Insufficient seawater pump operation	10. Worn pump impeller
11. Obstruction in cooling system such as casting flash, sand, rust, salt, etc.	11. Refer to water flow diagram for engine type being serviced
12. Engine circulating pump defective	
13. Also refer to ENGINE OVERHEATS (MECHANICAL)	
IMPORTANT: In addition to previous checks, make the following checks if engine is equipped with closed cooling.	
14. Low coolant level	
15. Anti-freeze not mixed properly	15. Anti-freeze should be mixed 50/50 or maximum 60/40. 60% anti-freeze, 40% water.
16. Heat exchanger cores plugged	
17. Water hoses reversed at the water distribution block	17. Refer to water flow diagrams Section 7, Part C
18. For further testing of the closed cooling system	18. Refer to Section 6, Part B

INSUFFICIENT WATER FLOW FROM MC-I STERN DRIVE UNIT SEAWATER PICKUP PUMP

CAUSE	SPECIAL INFORMATION
1. Seawater shut-off valve partially or fully closed (if equipped)	
2. Water pickups clogged with foreign material	
3. Kinked or broken bell housing-to-gimbal housing water tube hose	
4. Corroded thru gimbal housing water tube	
5. Water pickup inserts warped. (Engine will overheat while boat is underway only.)	5. Pickup inserts must not protrude above gear housing surface or inserts will create an irregular or turbulent water flow over the water pickup holes. Consequently, this may cause loss of cooling water and subsequent engine overheating. This condition also can be identified by cavitation burn (pitting, erosion) on the gear housing in the area aft of the water pickup inserts.
6. Damaged gear housing or accessories improperly installed on boat bottom or transom (speedometer pickup, depth sounder transducer, etc.). Substantial amount of barnacles or other marine growth on gear housing or boat bottom. (Engine will overheat while underway only.)	6. An object or an irregularity on boat or gear housing in area close to water pickups could create turbulence in water flow going to water pickups. This could aerate the water flow and cause engine to overheat.
7. Stern drive installed too high on transom or drive unit trimmed too far out allowing air to be drawn into pump. (Engine will overheat while underway only.)	7. Contact boat company if stern drive is installed too high. Instruct operator on proper trimming technique if unit is trimmed out too far.
8. Bell housing-to-drive shaft housing "O" ring missing or damaged	
9. Faulty seawater pickup pump	
10. Seawater pickup pump water tube corroded thru	
11. Drive shaft housing water pocket cover cracked	
12. Broken-off impeller blade or other obstruction in water passages (usually lodges in drive shaft housing water pocket cover or cross-drilled water passage).	12. To check cross-drilled water passage in drive shaft housing, remove welch plug and pipe plug located under decal on starboard side of housing. Drive unit must be shifted into reverse to remove pipe plug.
13. Water passage in drive shaft housing improperly drilled	

INSUFFICIENT WATER FLOW FROM BELT DRIVEN SEAWATER PICKUP PUMP

CAUSE	SPECIAL INFORMATION
1. Drive belt	1. Loose or broken
2. Seawater shut-off valve partially or fully closed	
3. Clogged or improperly installed sea strainer	
4. Loose hose connections between seawater pickup and seawater pump inlet	4. Pump will suck air, pump may fail to prime or will force air bubbles into cooling system
5. Seawater inlet hose kinked or plugged	
6. Seawater pickup clogged	
7. Obstruction on boat bottom causing water turbulence	7. Obstruction will be in front of seawater pickup, causing air bubbles to be forced into cooling system
8. Faulty seawater pump	

POWER STEERING

POOR, ERRATIC, OR NO ASSIST

CAUSE	SPECIAL INFORMATION
1. Drive belt	1. Broken or out of adjustment
2. Low fluid level	
3. Air in system	3. Air leak in lines, pump, or air from installation. Refer to Section 7 for bleeding procedure.
4. Leaking hoses	4. Refer to Section 7 for bleeding procedure
5. Steering cable and/or steering helm	5. Cable or helm partially froze from corrosion or rust, cable over lubricated, improper cable installation
6. Binding in stern drive unit	6. Refer to appropriate "Stern Drive Service Manual"
7. Restriction in hydraulic hoses	7. Causes a loss of pressure
8. Control valve not positioned properly, not balanced properly, or the mounting nut is loose	
9. Mounting bracket adjusting screw loose or mounting tube is loose	
10. Faulty pump	10. Flow control valve may be sticking
11. Worn piston ring or scored housing bore in cylinder	11. Causes loss of pressure
12. Leaking valve body or loose fitting spool	

NOISY PUMP

CAUSE	SPECIAL INFORMATION
1. Drive belt	1. Check tension
2. Low fluid level	
3. Air in fluid	3. Air leak in lines, pump, or air from installation. Refer to Section 7 for bleeding procedure.
4. Faulty pump	4. Use stethoscope to listen for noise in the pump
5. Restricted fluid passages	5. Kinks or debris in hoses or debris in passages
6. Stop nut adjusted improperly	6. Refer to appropriate stern drive service manual
7. Steering cables installed that do not meet BIA standards	7. Refer to appropriate stern drive service manual

FLUID LEAKS

CAUSE	SPECIAL INFORMATION
1. Loose hose connections	1. Refer to Section 7 for bleeding procedure
2. Damaged hose	
3. Oil leaking from top of pump	3. System overfilled, fluid contains water, fluid has air in it
4. Cylinder piston rod seal	
5. Faulty seals in valve	
6. Faulty seals or "O" rings in pump	
7. Cracked or porous metal parts	

REMOVAL-INSTALLATION-ALIGNMENT

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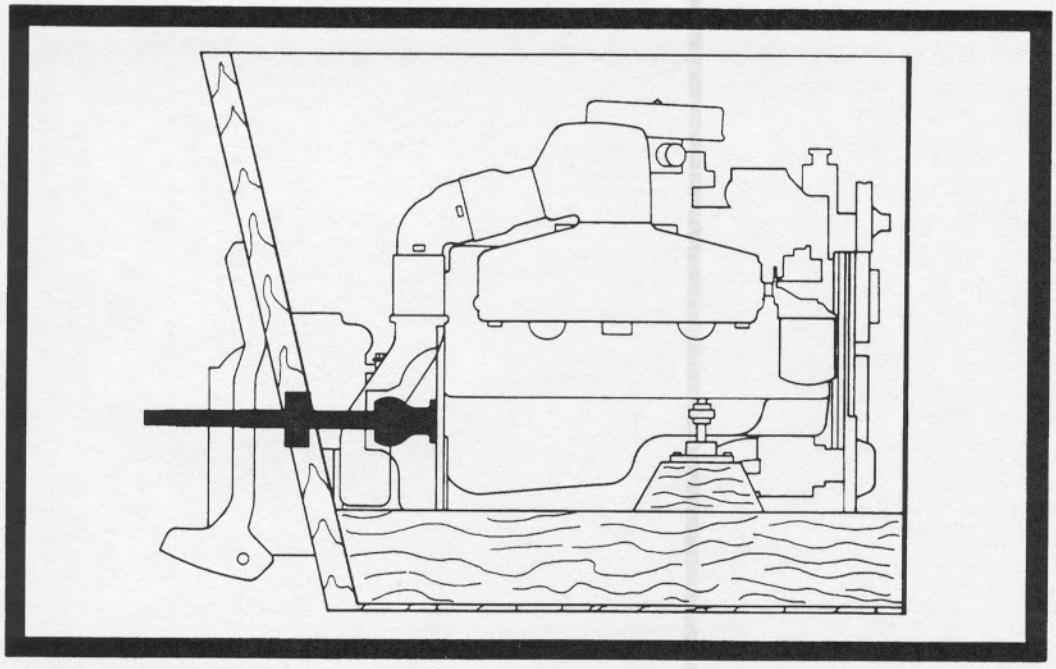

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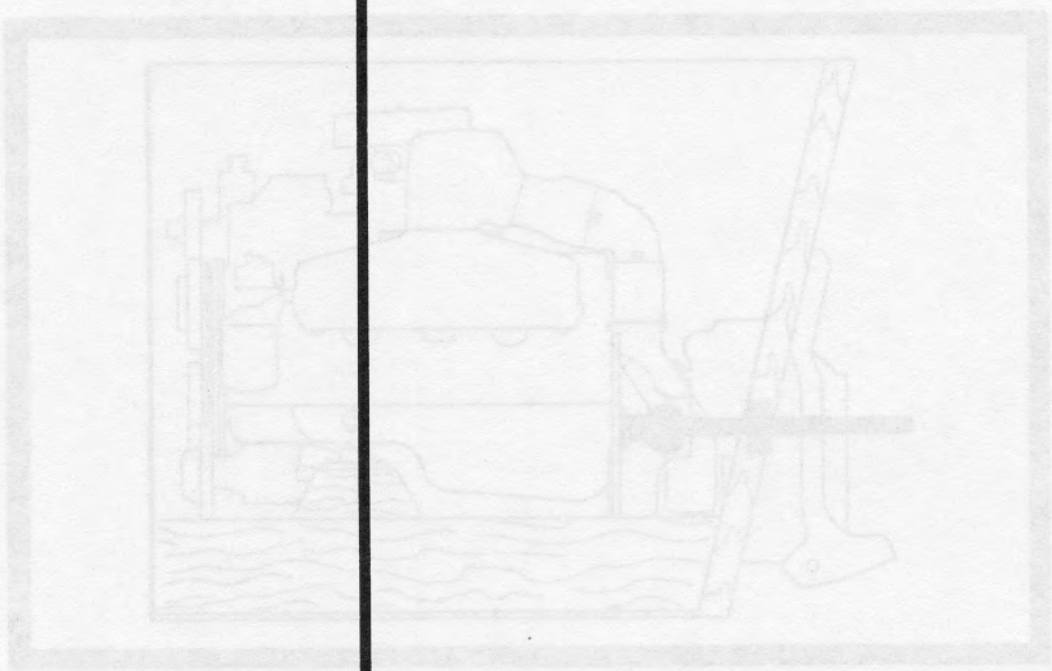


TORQUE SPECIFICATIONS

Fastener Location	Lb. Ft. (N.m)	Lb. In. (N.m)
Battery Cables	Securely	
Drive Unit Shift Cable Brass Barrel	Spread Cotter Pin	
Cable End Guide	(Note 1)	
Front Engine Mount	50-65 (68-82)	
Hose Clamps	Securely	
Power Steering Fluid Hose Fittings Large	20-25 (27-34)	
Small		96-108 (11-12)
Rear Engine Mounts	35-40 (47-54)	
Remote Control Shift Cable Brass Barrel	Securely	
Cable End Guide	(Note 1)	
Remote Control Throttle Cable Brass Barrel	Securely	
Cable End Guide	(Note 1)	
Fuel Pump Inlet Fitting	10-18 (14-24)	

NOTE 1: Tighten, then back nut off 1/2 turn.

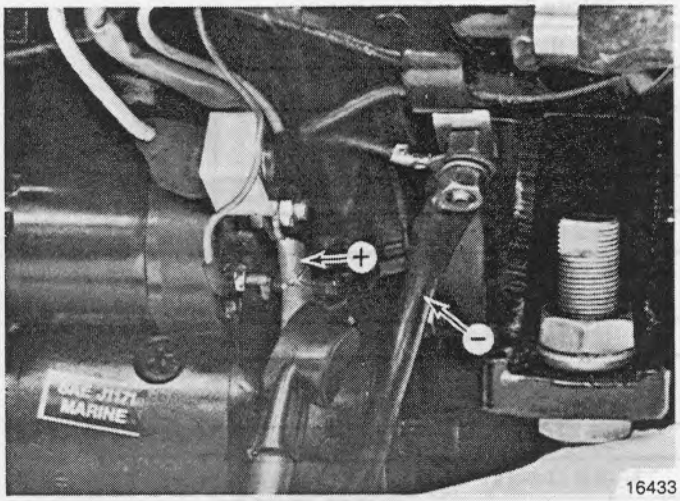
LUBRICANTS	
92-825407A2	Quicksilver 2-4-C Marine Lubricant
92-816391A4	Engine Coupler Spline Grease

TOOLS	
91-805475A1	Engine Alignment Tool

REMOVAL

NOTICE: Stern drive unit must be removed prior to engine removal. Refer to "Stern Drive Service Manual."

1. Disconnect battery cables at battery.
2. Disconnect battery cables from engine.



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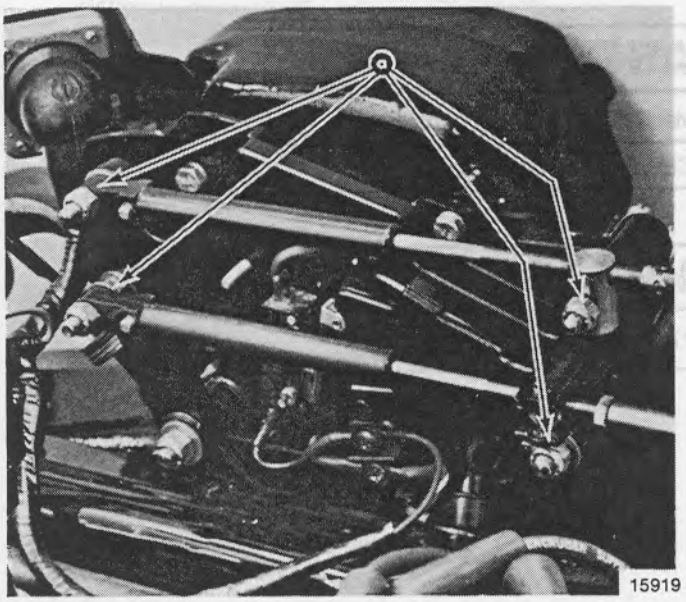
3. Disconnect fuel line entering fuel pump.
4. Disconnect shift cables.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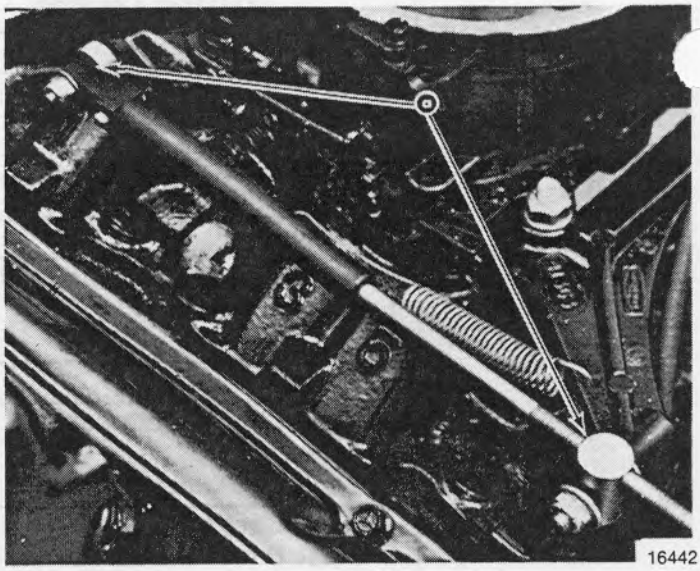
5. Disconnect throttle cables.

MODELS WITH 4 BARREL CARBURETOR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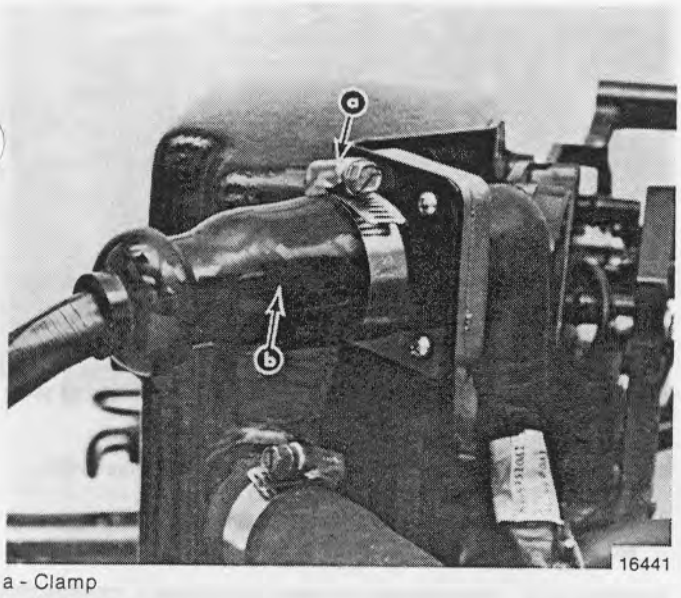
a - Remove Here

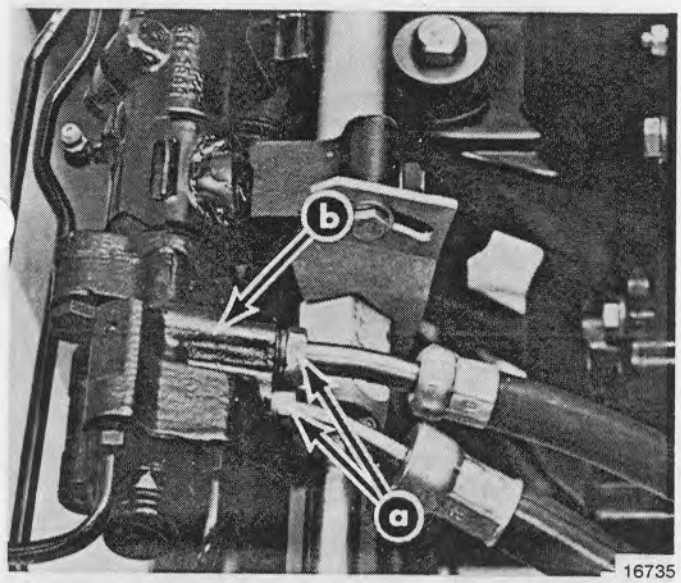
6. Loosen clamp, unplug harness.



16441

a - Clamp
b - Harness

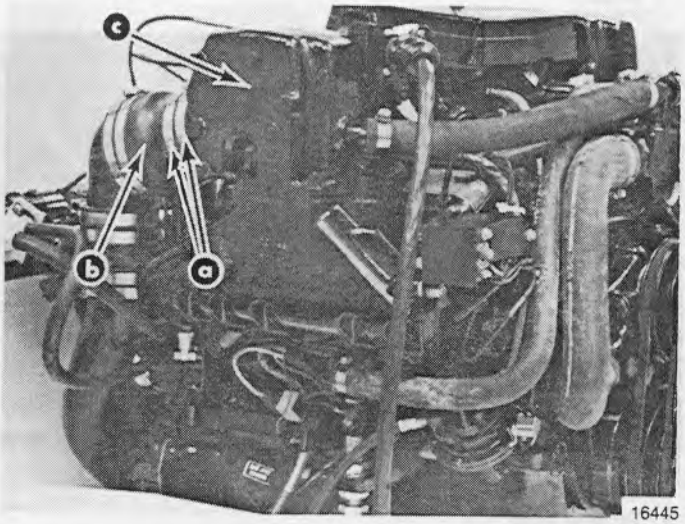
7. Disconnect power steering hoses from power steering unit.



16735

a - Power Steering Hoses
b - Power Steering Unit

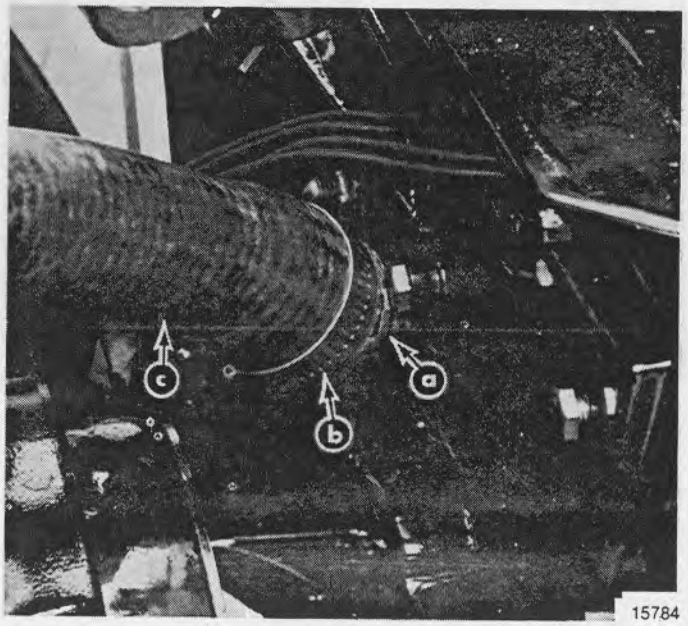
8. Loosen clamps and remove bellows from elbow.



16445

a - Clamps
b - Bellows
c - Elbow

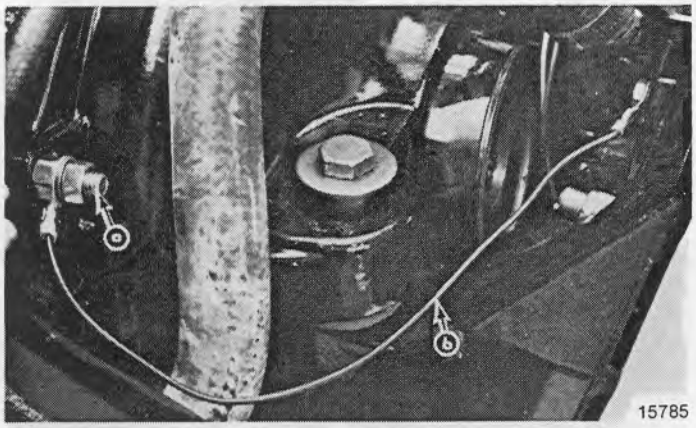
9. Loosen clamp and remove water inlet hose from water tube.



15784

a - Water Tube
b - Clamp
c - Water Inlet Hose

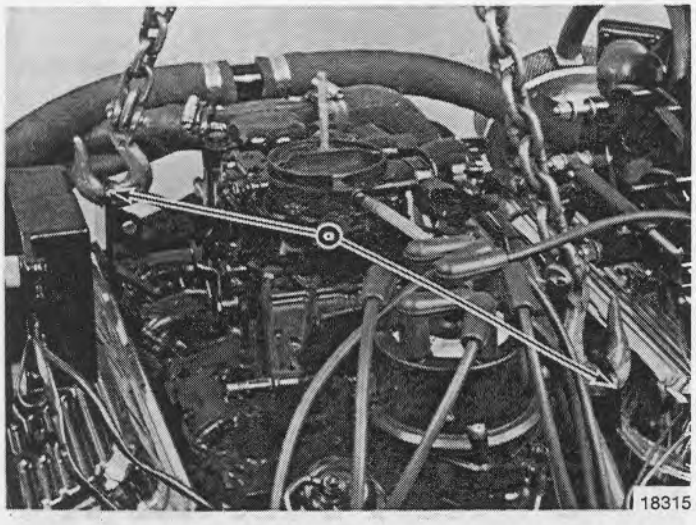
10. Disconnect ground wire from flywheel housing stud.



15785

a - Flywheel Housing Stud
b - Ground Wire

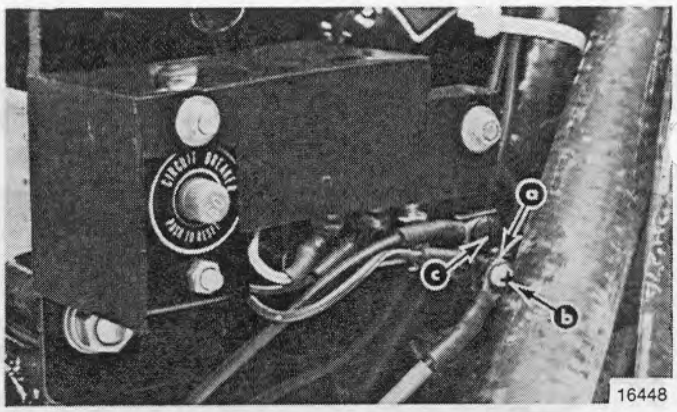
11. Attach lifting hooks to engine lifting eyes.



18315

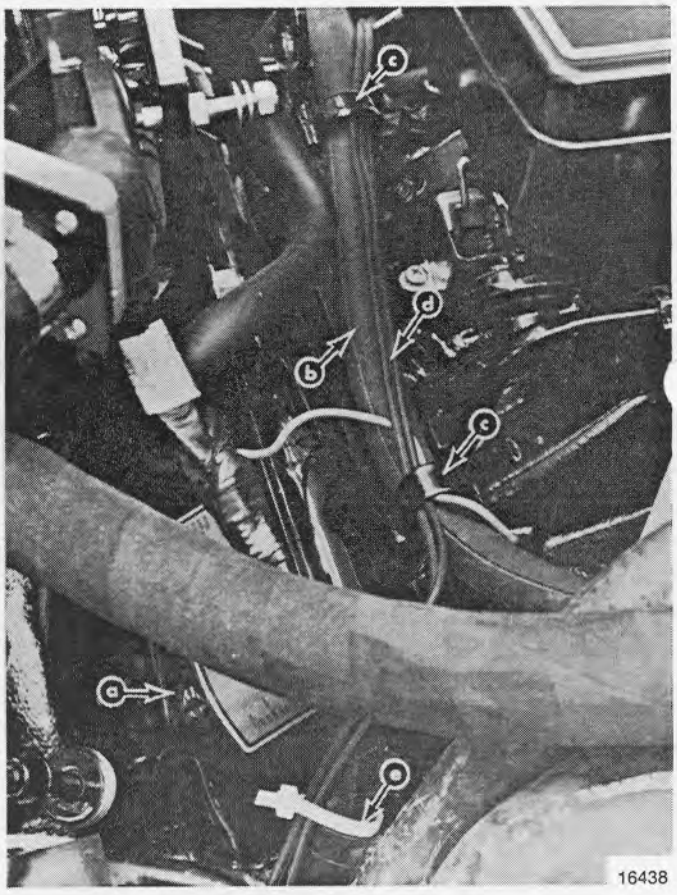
a - Lifting Eyes

12. Disconnect power trim position sender wires.



16448

a - Terminal Block
b - Trim Position Sender Lead with Brown or Purple Sleeve On Terminal Block with Brown/White Lead
c - Trim Position Sender Lead without Sleeve Terminal Block Mounting Screw

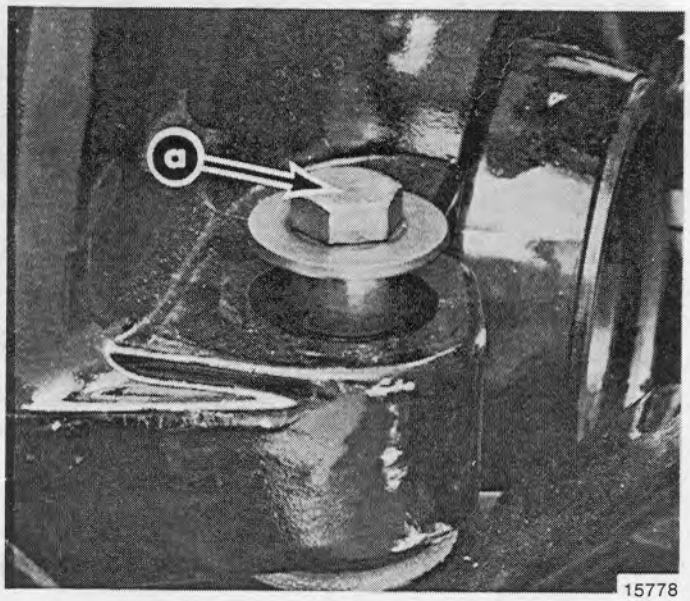


16438

a - Starboard Rocker Arm Cover
b - Power Steering Hydraulic Hose
c - Hose Clips
d - Trim Position Sender Leads
e - Sta-Strap

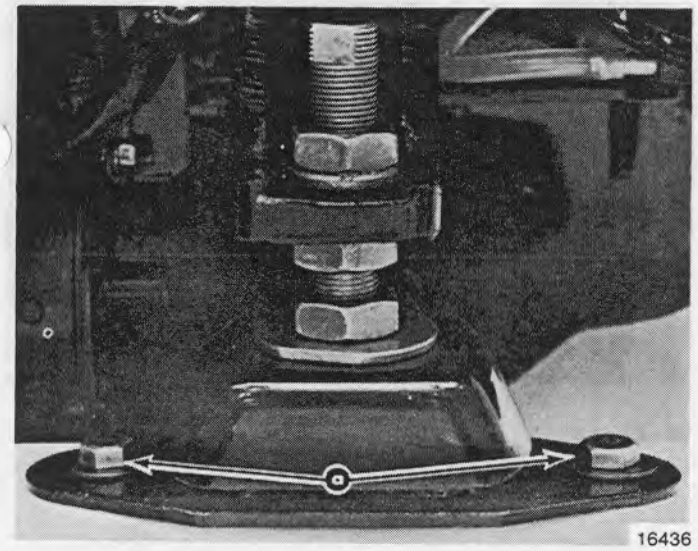
13. Disconnect all other ground or accessory wires connected to engine.

14. Remove rear mount bolts.



a - Rear Mount Bolt

15. Remove front mount bolts.

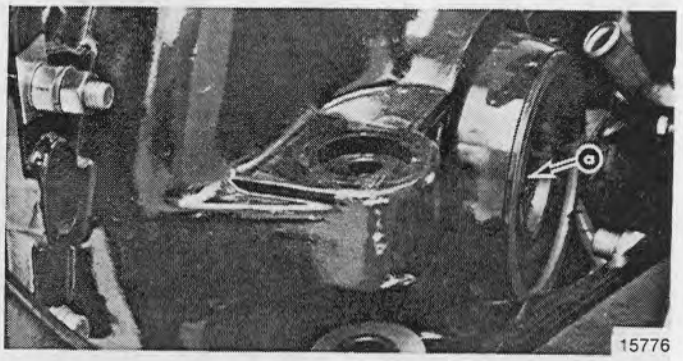


a - Front Mount Bolts

16. Carefully lift engine.

Installation

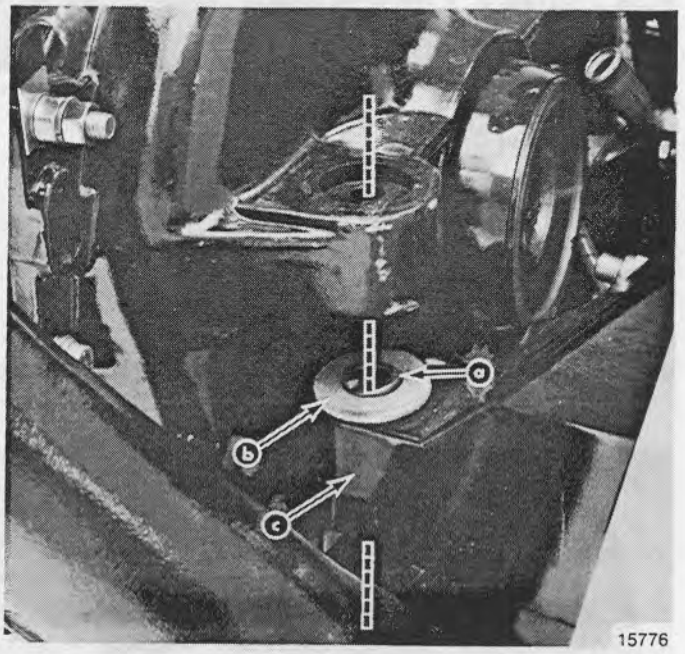
1. Lubricate engine coupler with Engine Coupler Spline Grease.



a - Engine Coupler

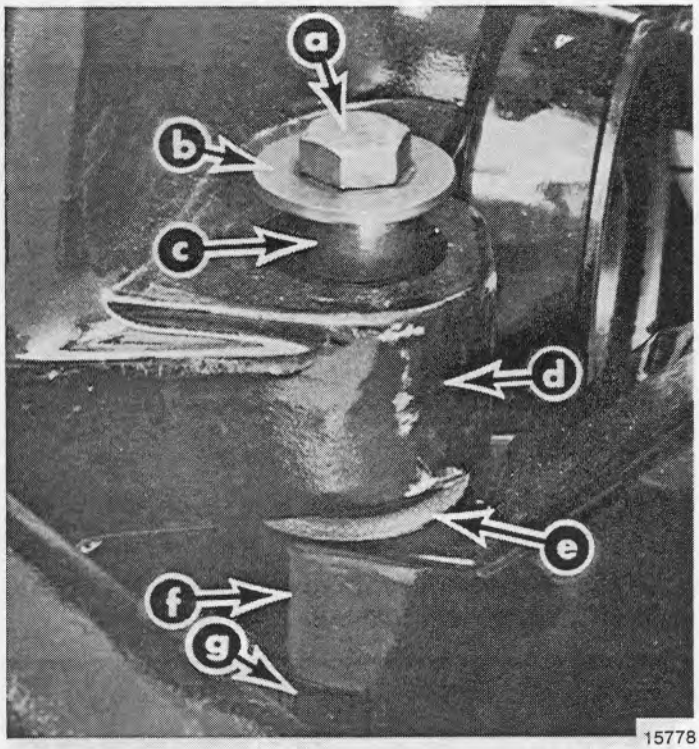
2. Attach lifting hooks to lifting eyes on engine and carefully lift engine into boat.

3. Install fiber washer and double wound lockwashers, then lower engine onto rear engine mounts.



a - Double Wound Lockwasher
b - Fiber Washer
c - Rear Engine Mount

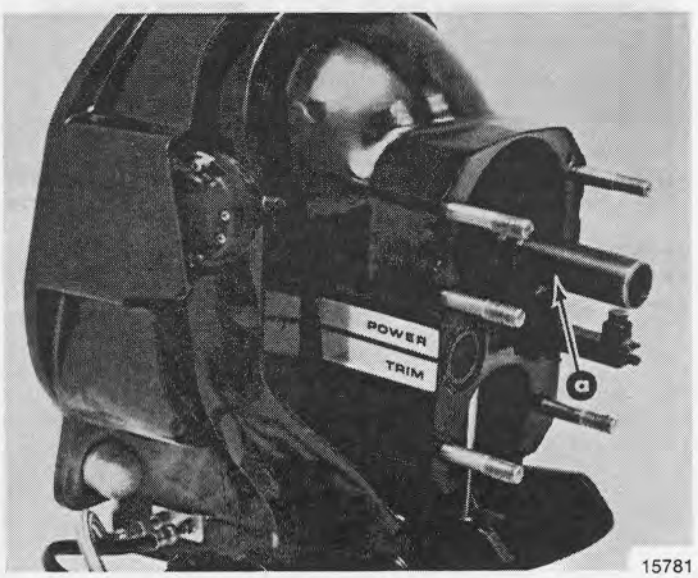
4. Install rear mounting bolts and torque to specifications.



15778

a - Mounting Bolt
b - Washer
c - Spacer
d - Rear Engine Mount
e - Fiber Washer
f - Rear Engine Mount
g - Elastic Stop Nut (Not Shown)

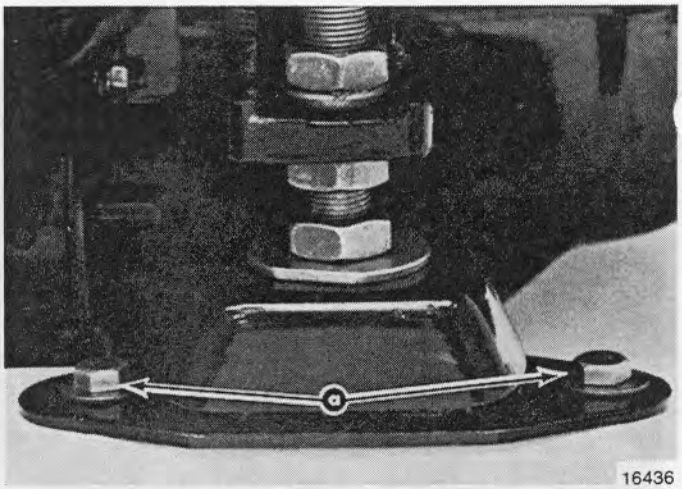
5. Install alignment tool thru gimbal housing and into engine coupler.



15781

a - Alignment Tool

6. Align front engine mounts with holes in stringer and install fasteners.

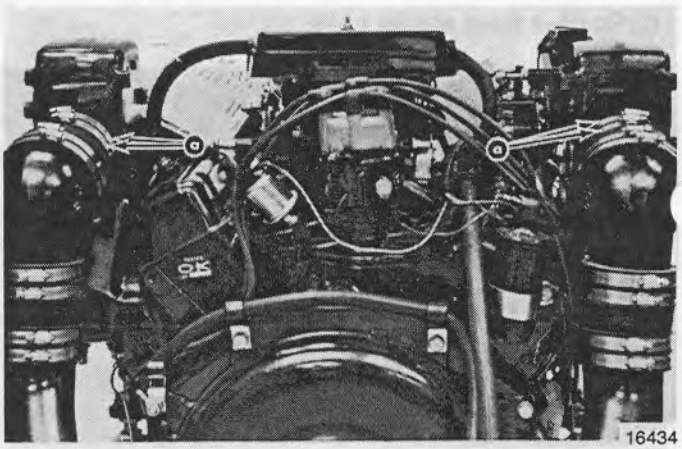


16436

a - Fasteners

IMPORTANT: Refer to "Alignment" before proceeding.

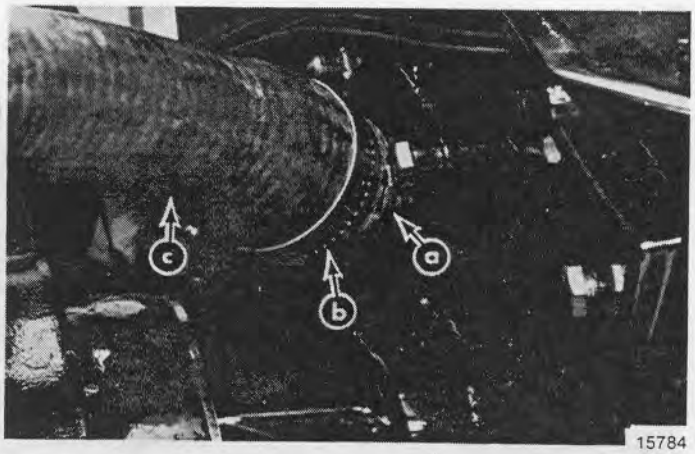
7. Install exhaust bellows to exhaust elbows and secure with clamps. Tighten securely.



16434

a - Clamps

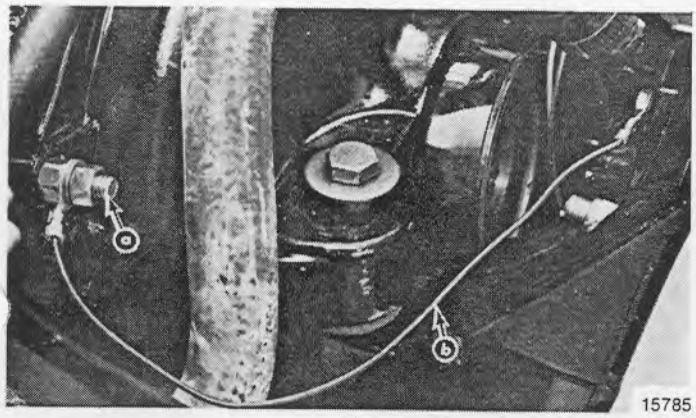
8. Attach water inlet hose to water tube, secure with hose clamp, tighten securely.



15784

a - Water Tube
b - Hose Clamp
c - Inlet Hose

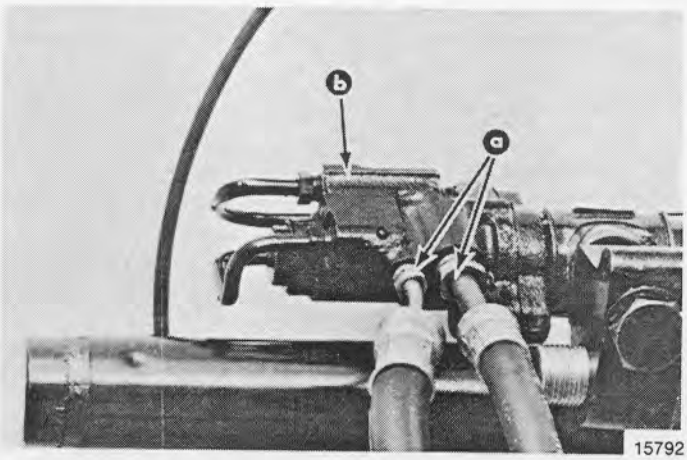
9. Connect ground wire. Tighten securely.



15785

a - Flywheel Housing Stud
b - Ground Wire

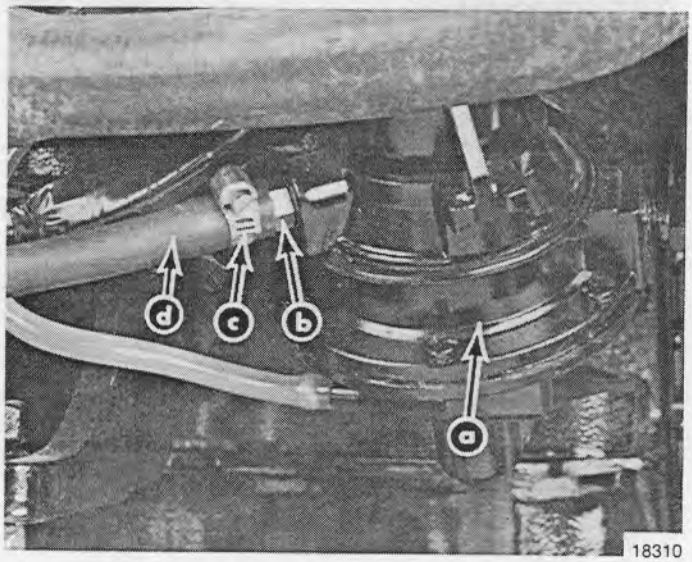
10. Connect power steering lines to power steering unit and tighten to specifications.



15792

a - Power Steering Lines
b - Power Steering Unit

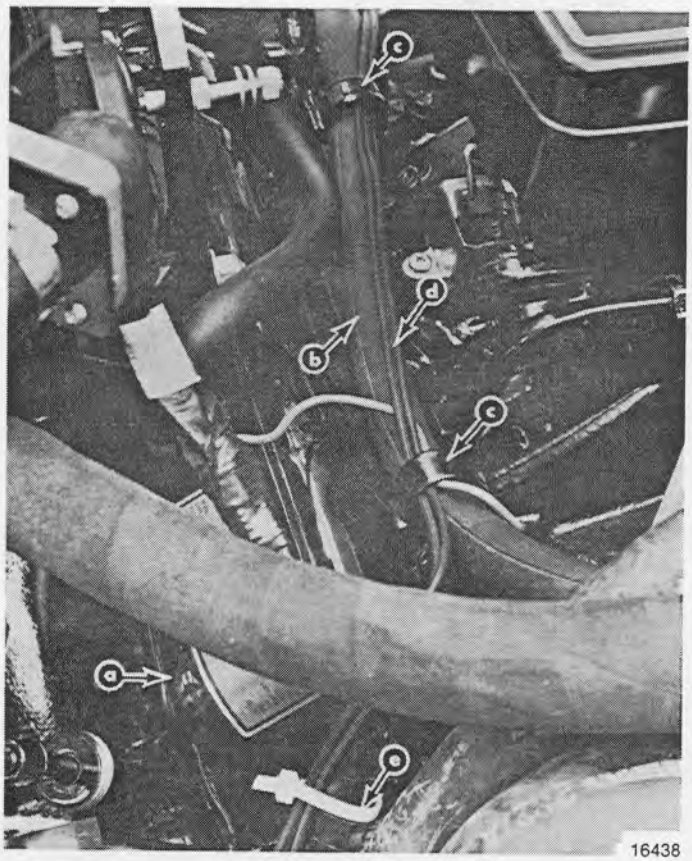
11. Install fuel line to fuel pump inlet, torque fitting to specifications and tighten clamp securely.



18310

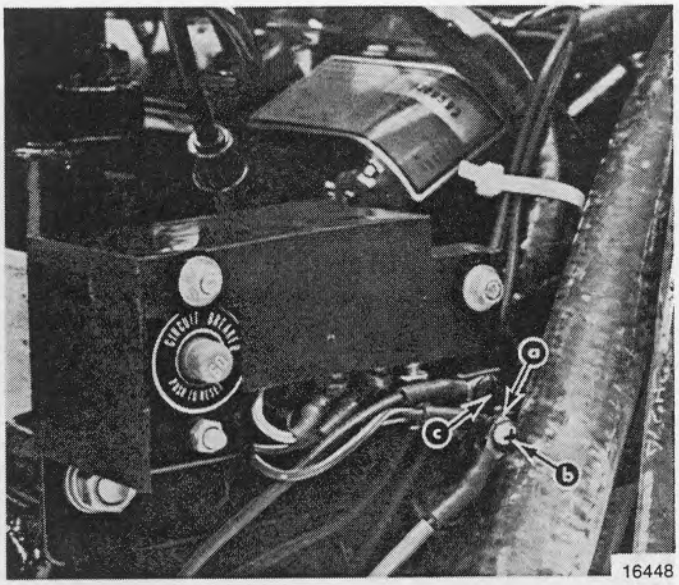
a - Fuel Pump
b - Fitting
c - Clamp
d - Fuel Line

12. Connect power trim position sender wires.



16438

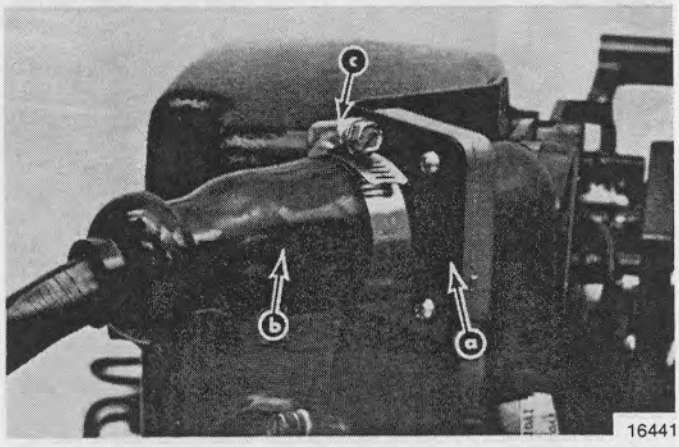
a - Starboard Rocker Arm Cover
b - Power Steering Hydraulic Hose
c - Hose Clips
d - Trim Position Sender Leads (Route Thru Hose Clips along with Power Steering Hydraulic Hose)
e - Sta-Strap Leads at This Location



16448

a - Terminal Block
b - Connect Trim Position Sender Lead with Brown or Purple Sleeve to Terminal On Terminal Block to Which Brown/White Lead is Already Attached
c - Connect Trim Position Sender Lead without Sleeve to Terminal Block Mounting Screw

13. Plug in wiring harness and secure with hose clamp. Tighten clamp securely.

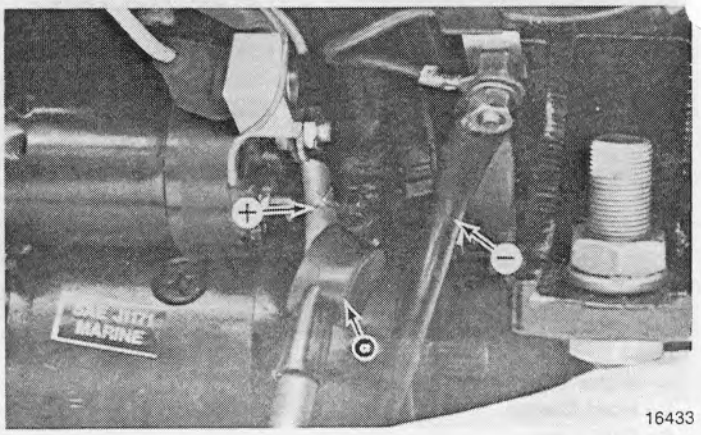


16441

a - Wiring Harness Bracket
b - Wiring Harness Plug
c - Hose Clamp

14. Reconnect any ground or accessory wires that have been removed.

15. Connect battery cables to starter and ground. Tighten securely and cover starter connection with rubber boot.



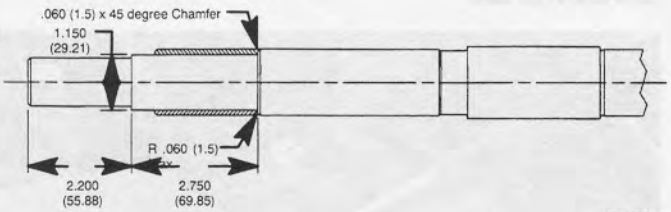
16433

a - Rubber Boot

16. Connect cables to battery and tighten securely.

Alignment

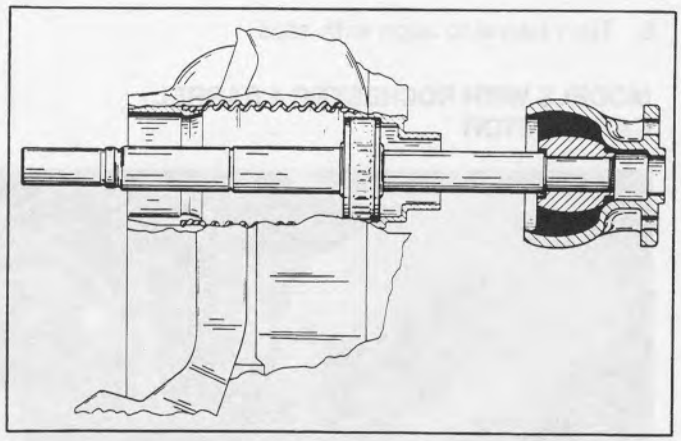
To ensure more engine coupler engagement modify alignment tool as shown.

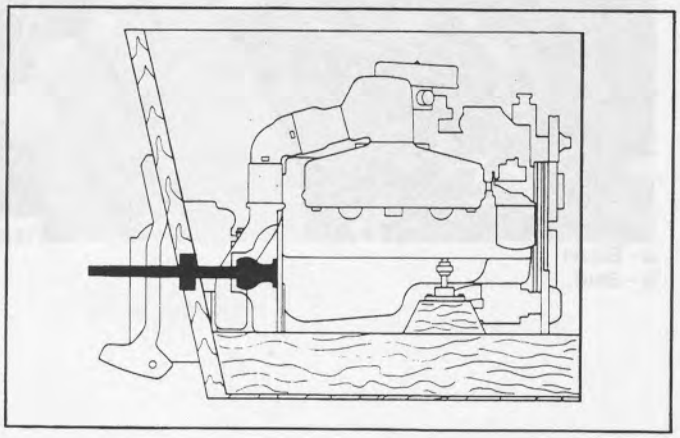


71551

a - To Engine Coupling

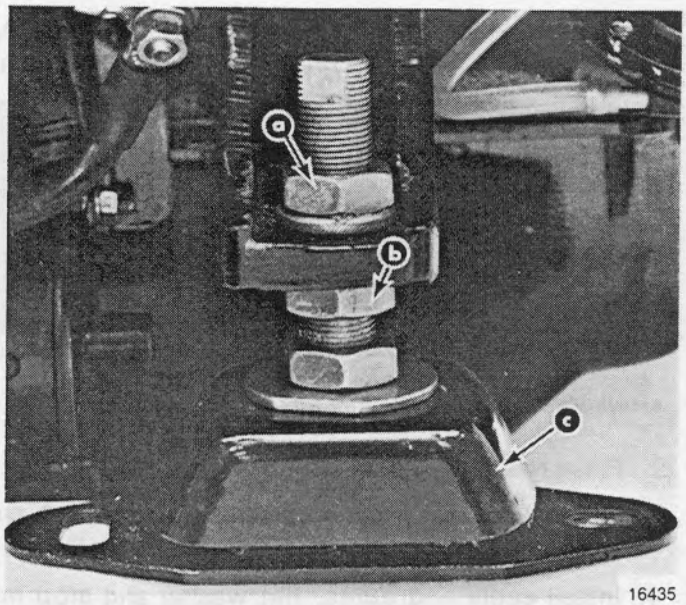
1. Insert alignment tool into and thru gimbal bearing and into engine coupling.





2. If shaft enters freely with no pressure alignment is correct.

3. If alignment is required loosen top locknut and raise or lower with bottom adjusting nut. (Align both sides equally.)



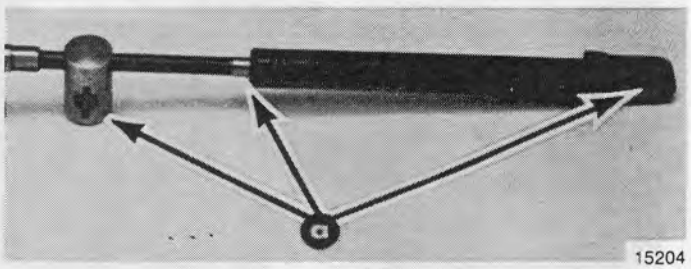
16435

a - Locknut
b - Adjusting Nut
c - Engine Mount

4. With alignment correct retighten nuts and recheck alignment. Tighten securely.

Attaching and Adjusting Throttle Cable

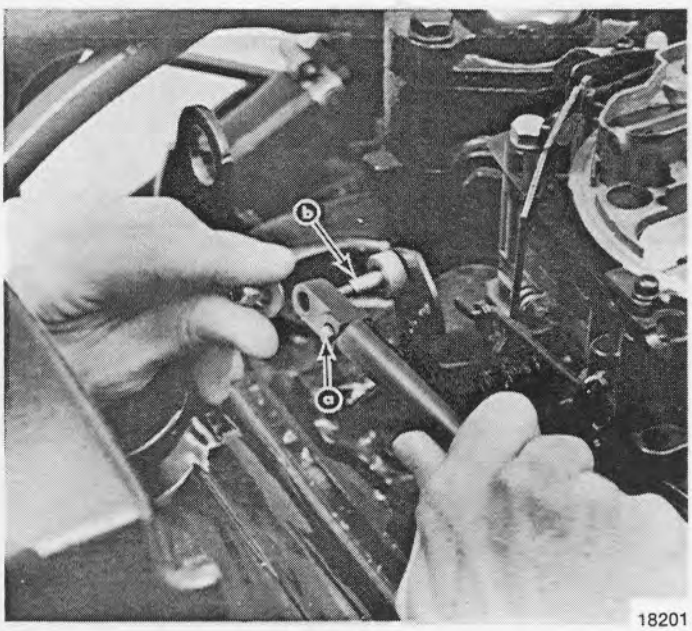
1. Lubricate cable ends (shift and throttle) with SAE Grade Motor Oil Multi-Lubricant, at locations shown.



a - Lubricate

2. Place remote control in neutral.
3. Lubricate anchor stud at carburetor with 2-4-C Multi-Lubricant.
4. Install cable end guide, flat washer and stop nut onto anchor stud and tighten to specifications.

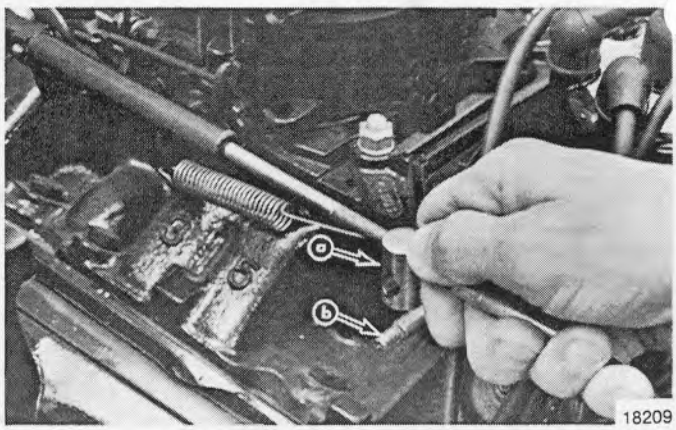
MODELS WITH ROCHESTER 4 BARREL CARBURETOR



a - Cable End Guide
b - Anchor Stud

5. Grasp cable behind brass barrel and push lightly to align barrel to stud.

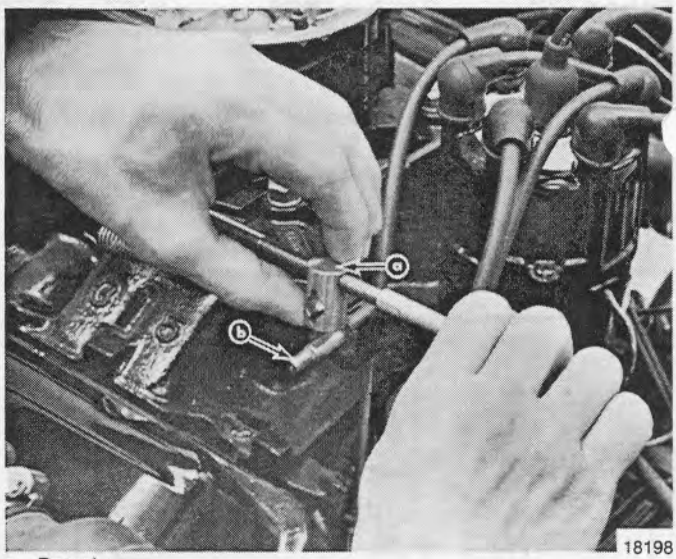
MODELS WITH ROCHESTER 4 BARREL CARBURETOR



a - Barrel
b - Stud

6. Turn barrel to align with stud.

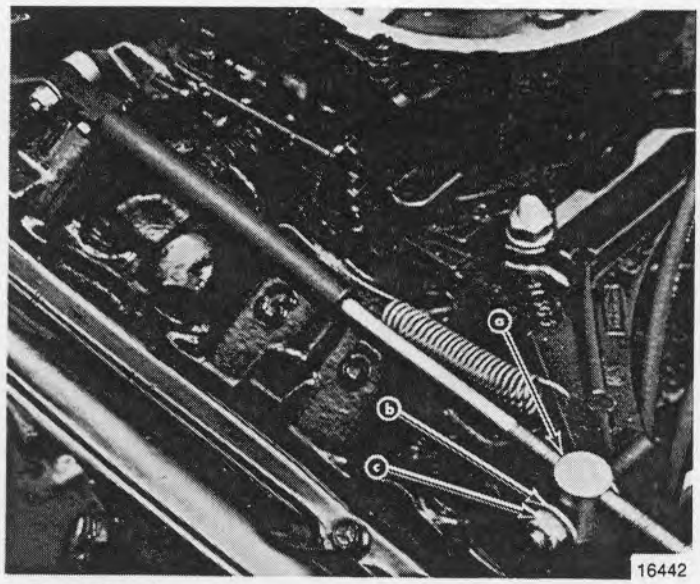
MODELS WITH ROCHESTER 4 BARREL CARBURETOR



a - Barrel
b - Stud

7. Secure brass barrel to stud with flat washer and locknut. Position barrel as shown.

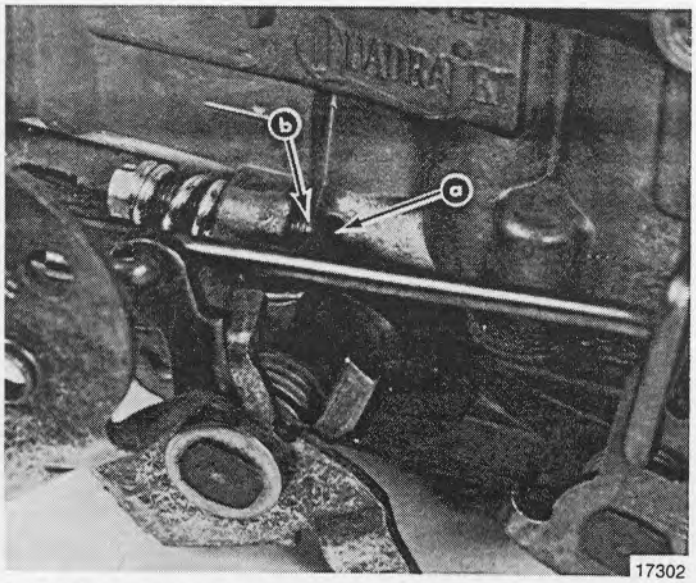
MODELS WITH ROCHESTER 4 BARREL CARBURETOR



a - Brass Barrel
b - Washer
c - Locknut

8. Shift to neutral, throttle plates must be completely closed.
9. Throttle linkage tang must contact idle speed adjustment screw.

MODELS WITH 4 BARREL CARBURETOR



a - Throttle Linkage Tang
b - Idle Speed Screw

10. Shift to full throttle. Throttle plates must be completely open.
11. Throttle linkage tang must make contact where shown.

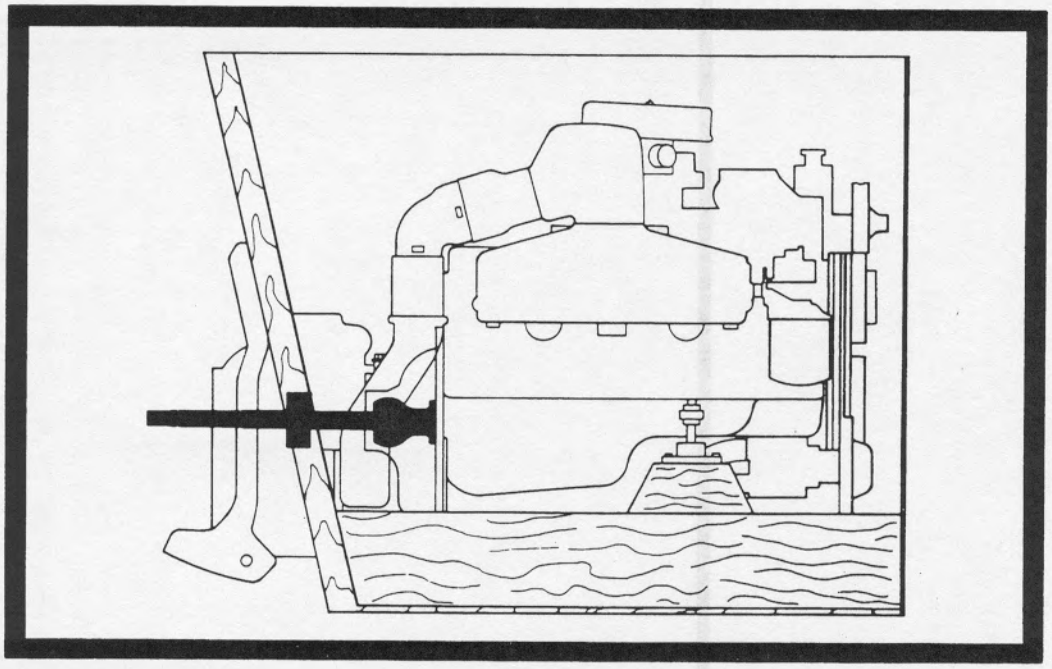
MODELS WITH 4 BARREL CARBURETOR

a - Throttle Linkage Tang
b - Contact Point

REMOVAL-INSTALLATION-ALIGNMENT

2

B



MCM 175, 185, 205 (262 C.I.D)
MCM 4.3L, 4.3LX (262 C.I.D.)

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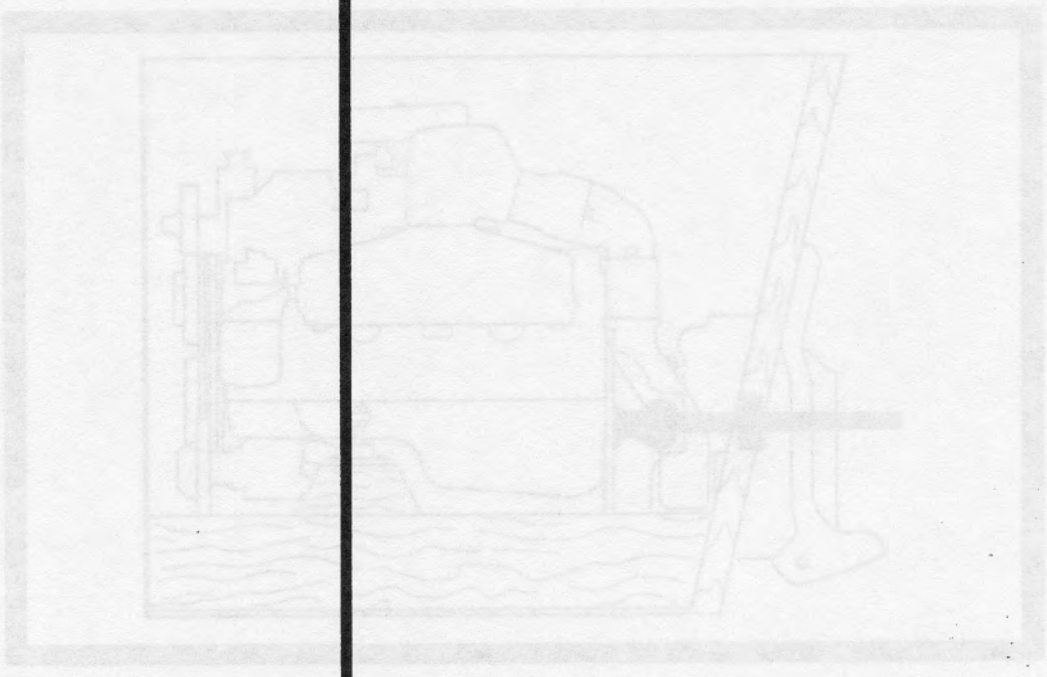


TORQUE SPECIFICATIONS

Fastener Location	Lb. Ft. (N.m)	Lb. In. (N.m)
Battery Cables	Securely	
Drive Unit Shift Cable Brass Barrel	Spread Cotter Pin	
Cable End Guide	(Note 1)	
Front Engine Mount	50-65 (68-82)	
Hose Clamps	Securely	
Power Steering Fluid Hose Fittings Large	20-25 (27-34)	
Small		96-108 (11-12)
Rear Engine Mounts	35-40 (47-54)	
Remote Control Shift Cable Brass Barrel	Securely	
Cable End Guide	(Note 1)	
Remote Control Throttle Cable Brass Barrel	Securely	
Cable End Guide	(Note 1)	
Fuel Pump Inlet Fitting	10-18 (14-24)	

NOTE 1: Tighten, then back nut off 1/2 turn.

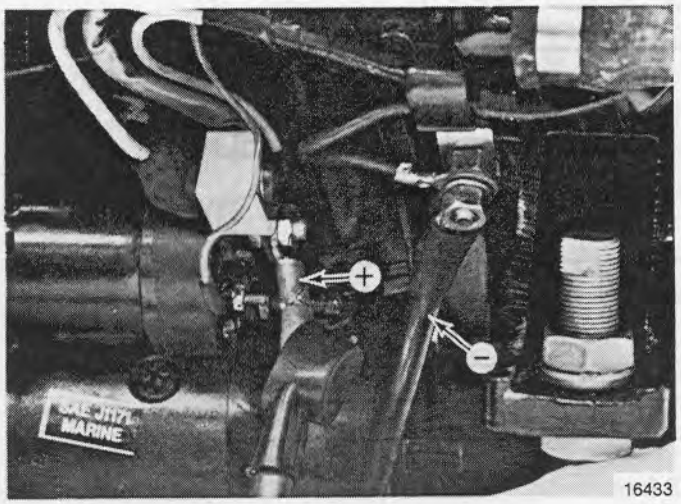
LUBRICANTS	
92-825407A2	Quicksilver 2-4-C Marine Lubricant
92-816391A4	Engine Coupler Spline Grease

TOOLS	
91-805475A1	Engine Alignment Tool

Removal

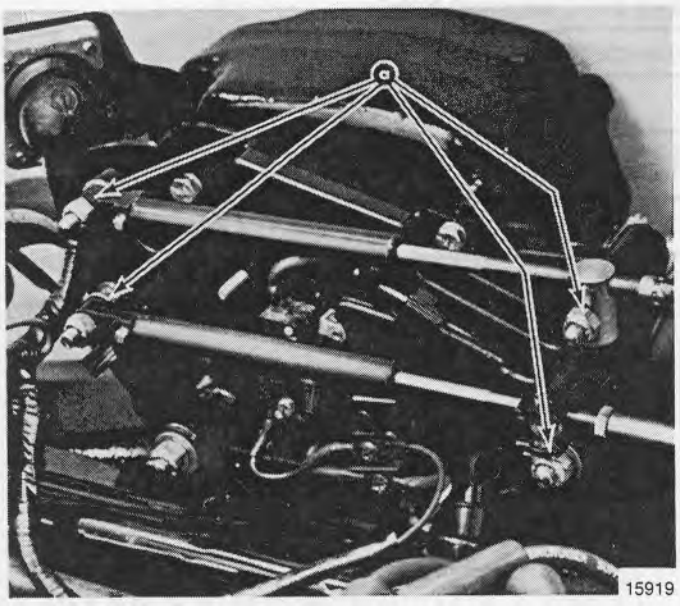
NOTICE: Stern drive unit must be removed prior to engine removal. Refer to "Stern Drive Service Manual."

1. Disconnect battery cables at battery.
2. Disconnect battery cables from engine.



16433

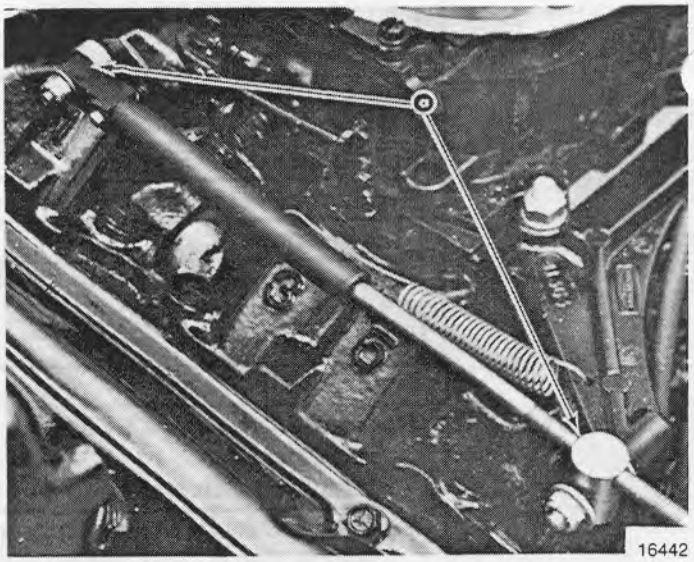
3. Disconnect fuel line entering fuel pump.
4. Disconnect shift cables.


15919

a - Remove Here

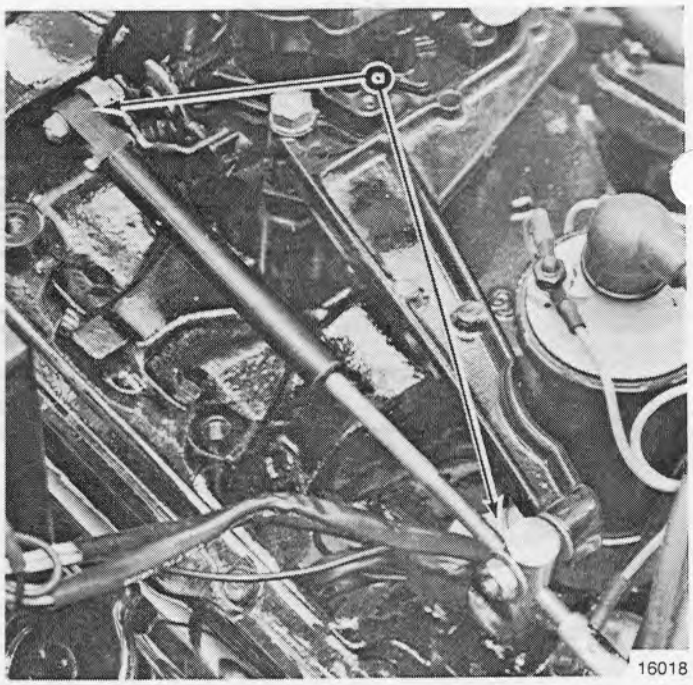
5. Disconnect throttle cables.

4 BARREL


16442

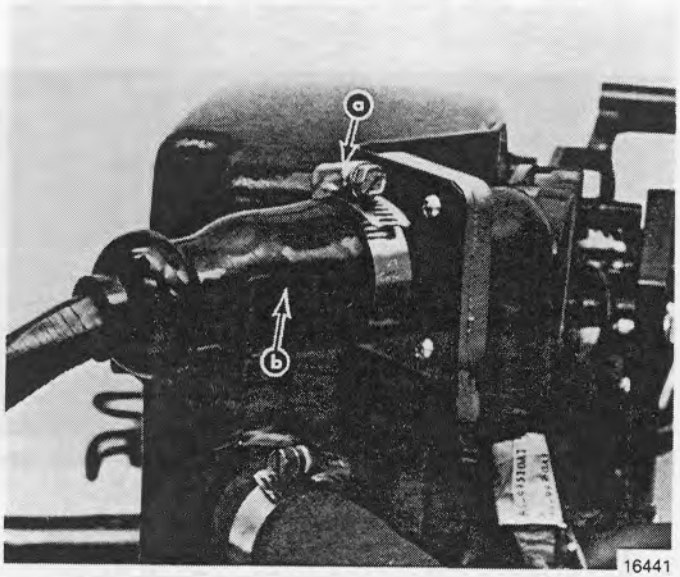
a - Remove Here

2 BARREL


16018

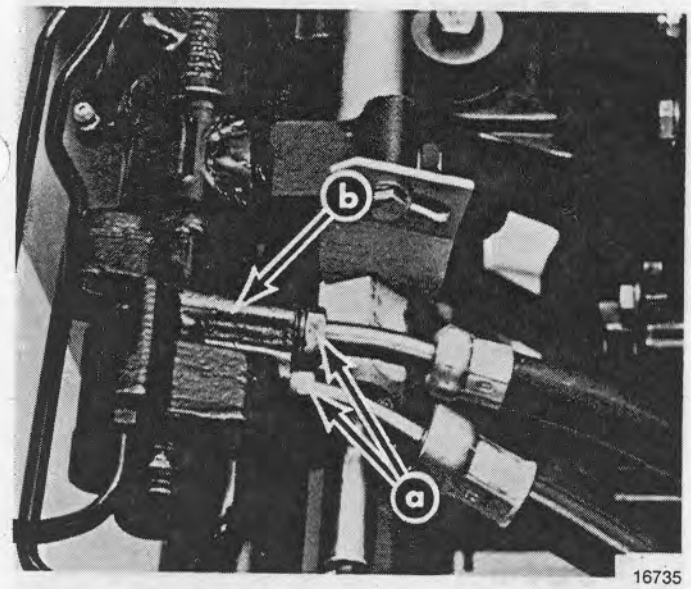
a - Remove Here

6. Loosen clamp, unplug harness.



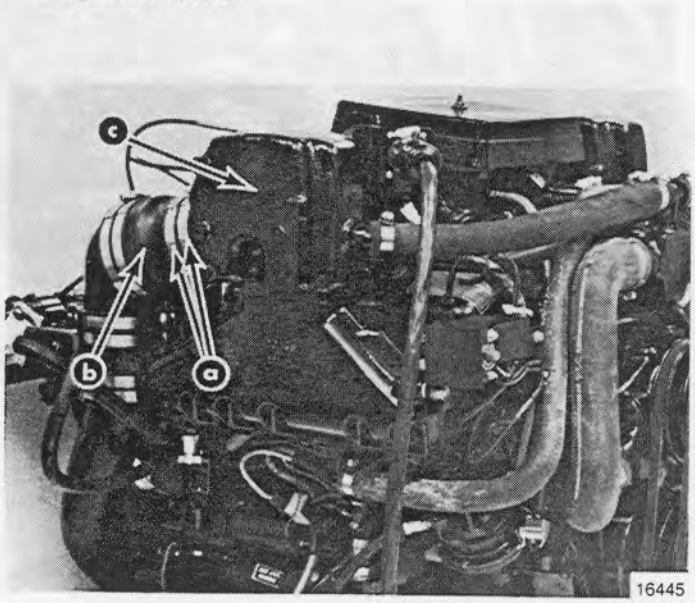
a - Clamp
b - Harness

7. Disconnect power steering hoses from power steering unit. Cap hoses and plug steering unit holes.



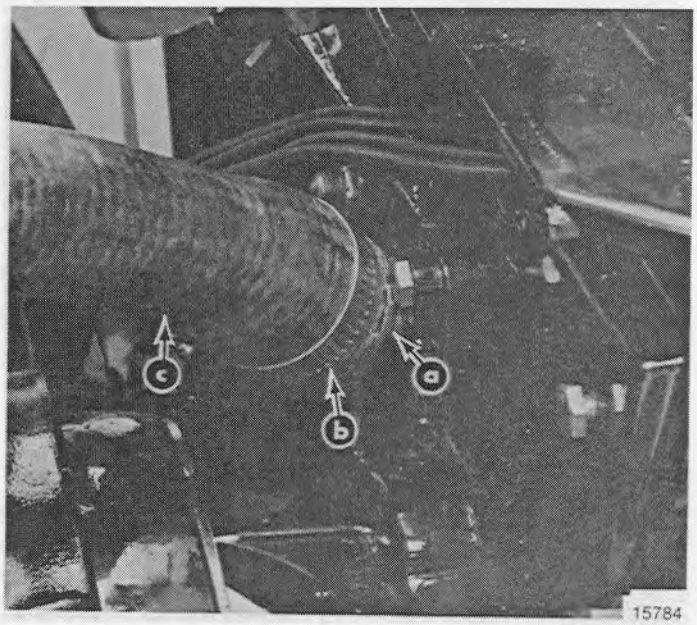
a - Power Steering Hoses
b - Power Steering Unit

8. Loosen clamps and loosen bellows so that intermediate exhaust pipe can lift out of bellows when engine is lifted.



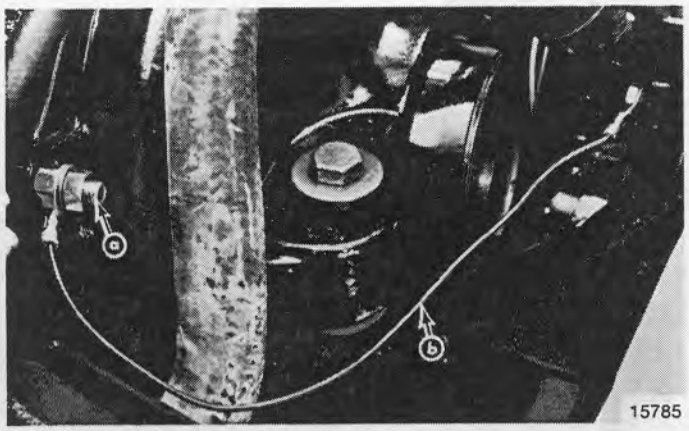
a - Clamps

9. Loosen clamp and remove water inlet hose from water tube.



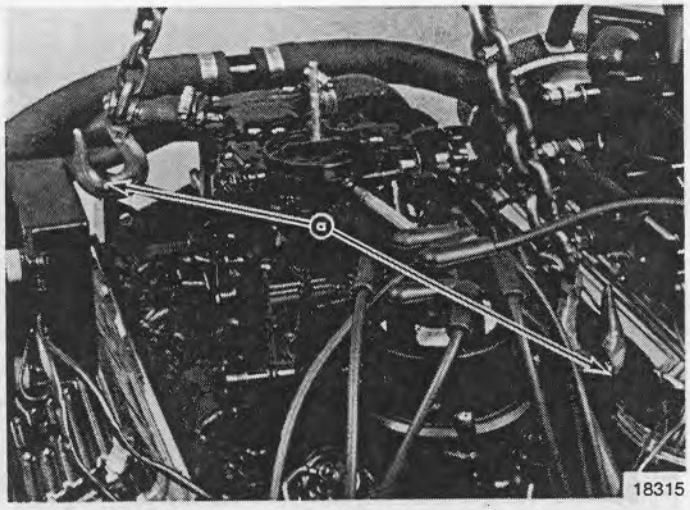
a - Water Tube
b - Clamp
c - Water Inlet Hose

10. Disconnect ground wire from flywheel housing stud.



a - Flywheel Housing Stud
b - Ground Wire

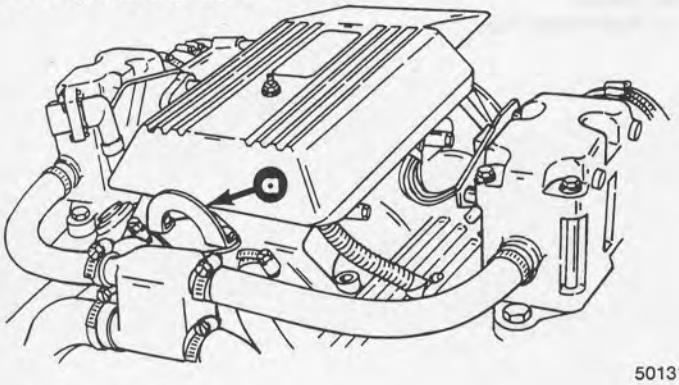
11. Attach lifting hooks to engine lifting eyes.



a - Lifting Eyes

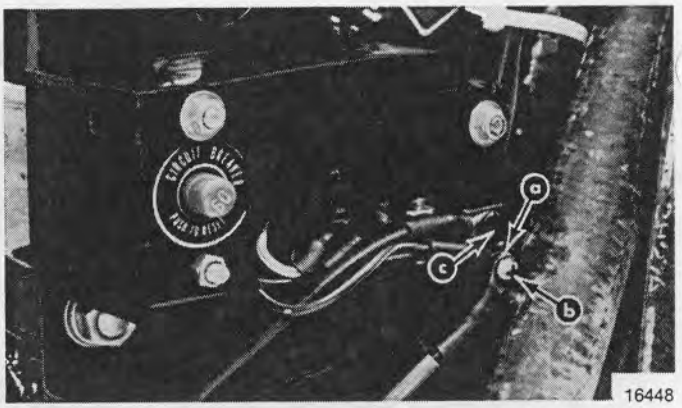
⚠CAUTION

If engine is equipped with center lifting eye, DO NOT use center lifting eye, which is bolted to thermostat housing, lo lift engine, as bolts may pull out of housing, which could result in extensive damage to engine and/or boat. The center lift-eye is used only to raise or lower engine, when engine is resting on rear mounts, for alignment purpose, only.

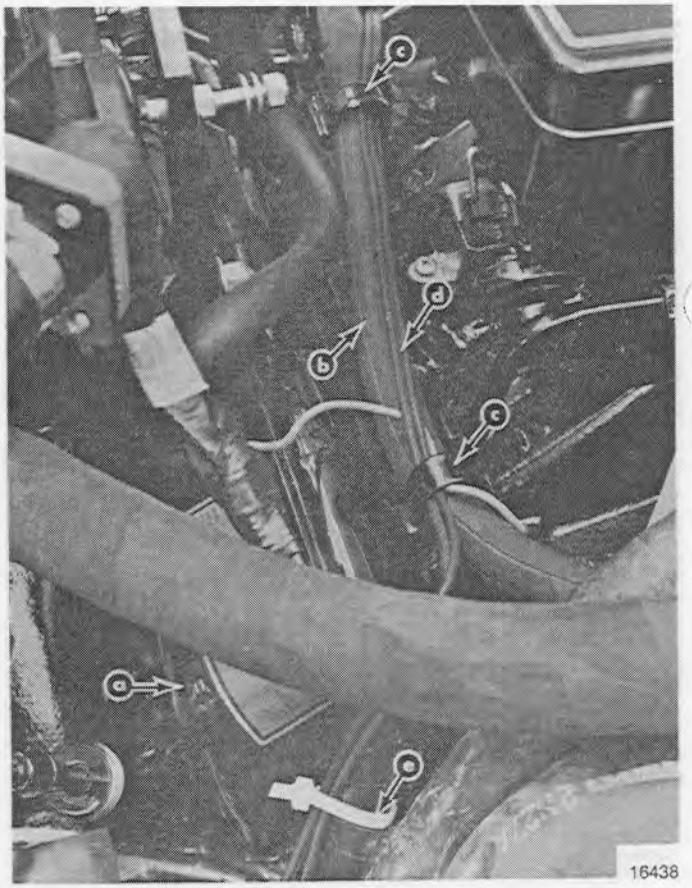


a - Center Lifting Eye

12. Disconnect power trim position sender wires. (Later Models - trim position wires are at rear of engine.)



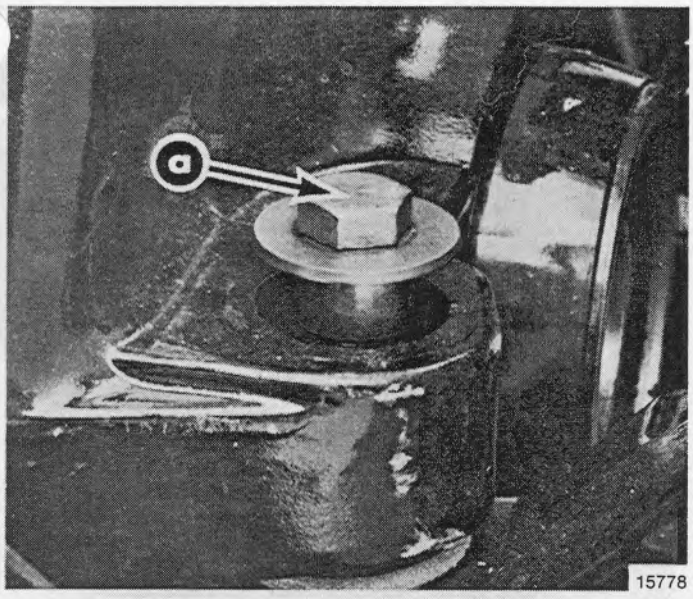
a - Terminal Block
b - Trim Position Sender Lead with Brown or Purple Sleeve On Terminal Block with Brown/White Lead (Earlier Models)
c - Trim Position Sender Lead without Sleeve Terminal Block Mounting Screw (Earlier Models)



a - Standard Rocker Arm Cover
b - Power Steering Hydraulic Hose
c - Hose Clips
d - Trim Position Sender Leads
e - Sta-Strap

13. Disconnect all other ground or accessory wires connected to engine.

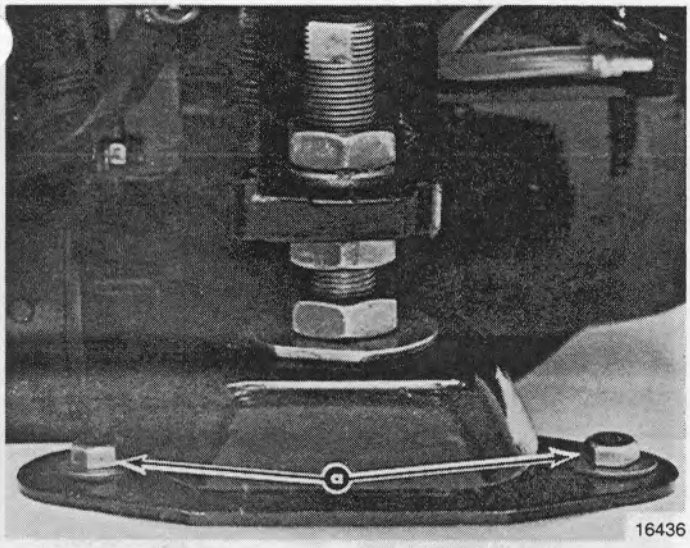
14. Remove rear mount bolts.



a - Rear Mount Bolt

RUBBER FRONT MOUNT

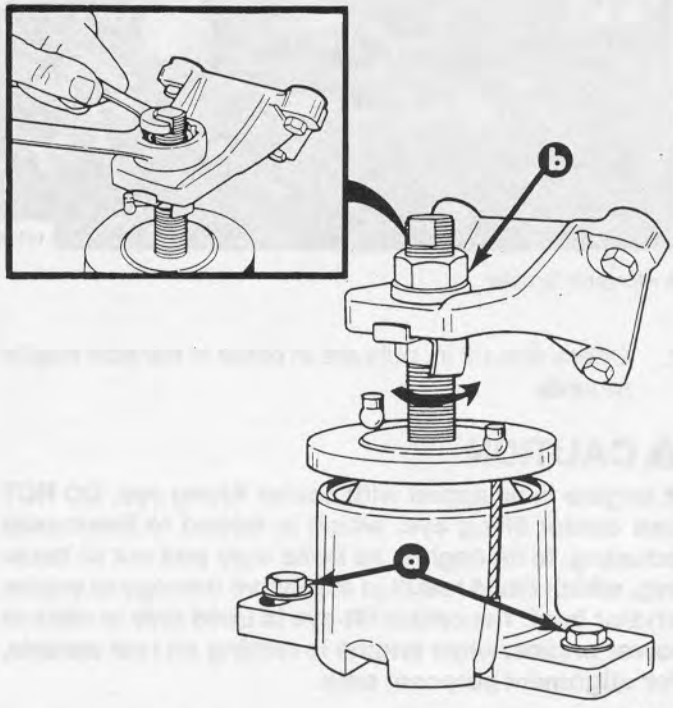
15. Remove front mount bolts.



a - Front Mount Bolts

FLUID FRONT MOUNT

IMPORTANT: Fluid Mount Only — You MUST use wrench on mount stud wrench-flat, to prevent twisting and damaging internal components of the mount, whenever adjustments, loosening, or tightening are performed. Do not turn base of mount without first loosening locknut "b."

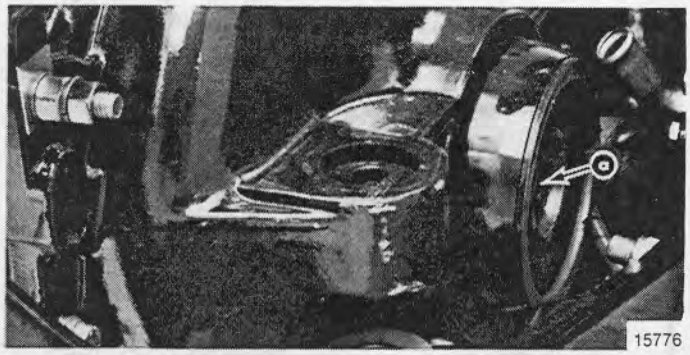


a - Front Mount Bolts
b - Locknut (and lockwasher)

16. Carefully lift engine.

Installation

1. Lubricate engine coupler with Quicksilver Engine Coupler Spline Grease.

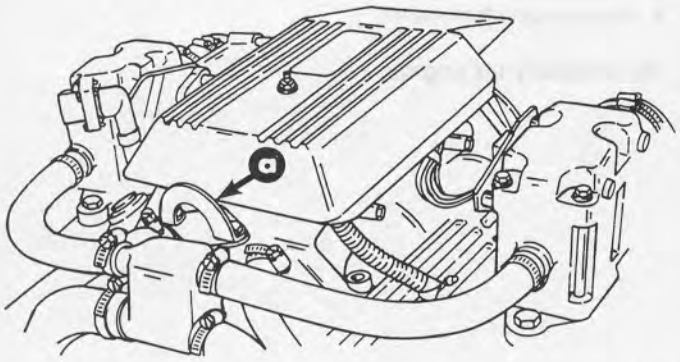


a - Engine Coupler

2. Check that 1/2 in. nuts are in place in transom engine mounts.

⚠ CAUTION

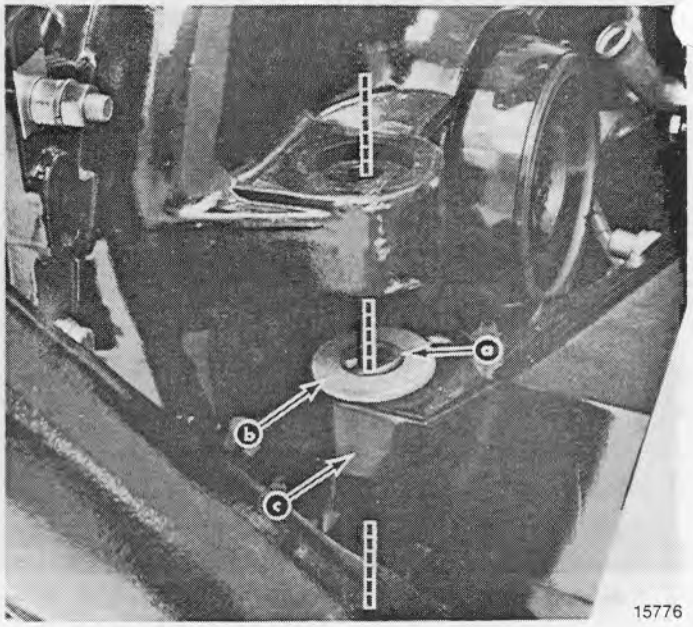
If engine is equipped with center lifting eye, DO NOT use center lifting eye, which is bolted to thermostat housing, lo lift engine, as bolts may pull out of housing, which could result in extensive damage to engine and/or boat. The center lift-eye is used only to raise or lower engine, when engine is resting on rear mounts, for alignment purpose, only.



a - Center Lifting Eye

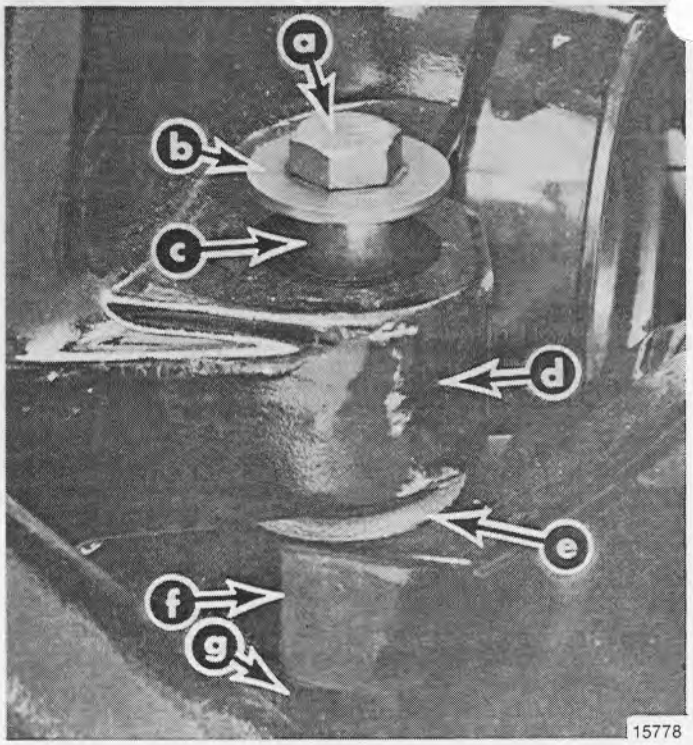
2C. Attach lifting hooks to lifting eyes on engine and carefully lift engine into boat.

3. Install fiber washer and double wound lockwasher, then lower engine onto rear engine mounts.



a - Double Wound Lockwasher
b - Fiber Washer
c - Rear Engine Mount

4. Install rear mounting bolts and torque to specifications.



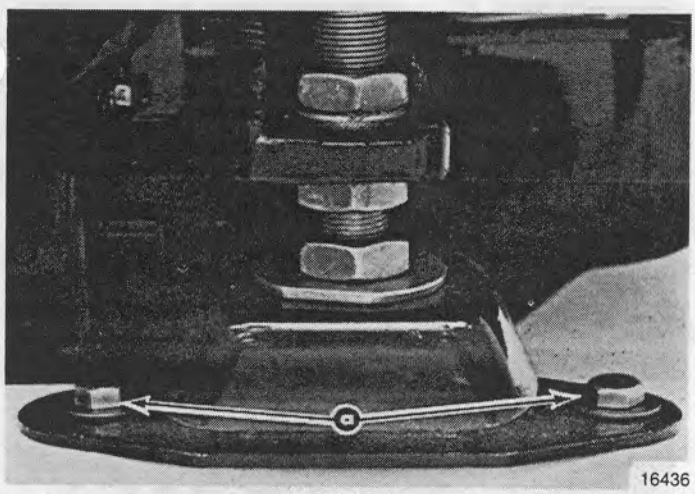
a - Mounting Bolt
b - Washer
c - Spacer
d - Rear Engine Mount
e - Fiber Washer
f - Rear Engine Mount
g - Elastic Stop Nut (Not Shown)

5. Install alignment tool thru gimbal housing and into engine coupler.

a - Alignment Tool

6. Align front engine mounts with holes in stringer and install fasteners.

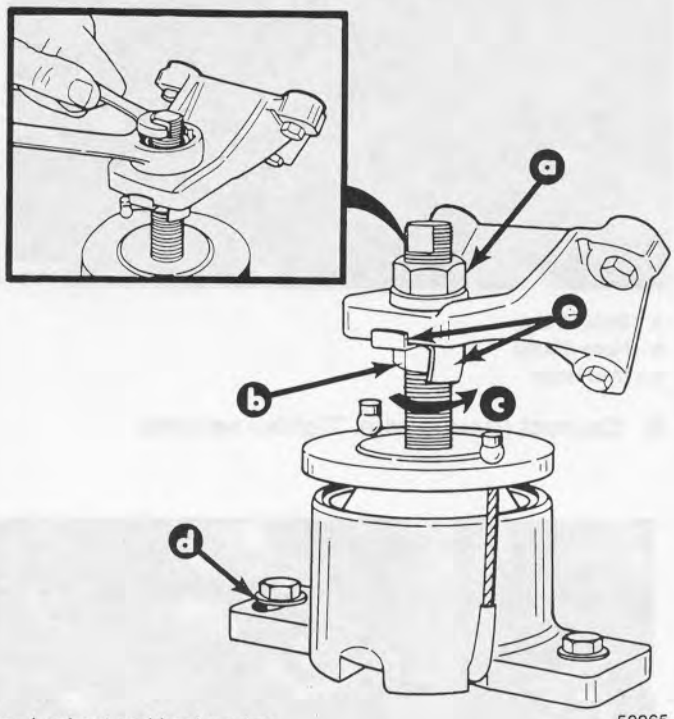
RUBBER FRONT MOUNTS



a - Fasteners

FLUID FRONT MOUNT

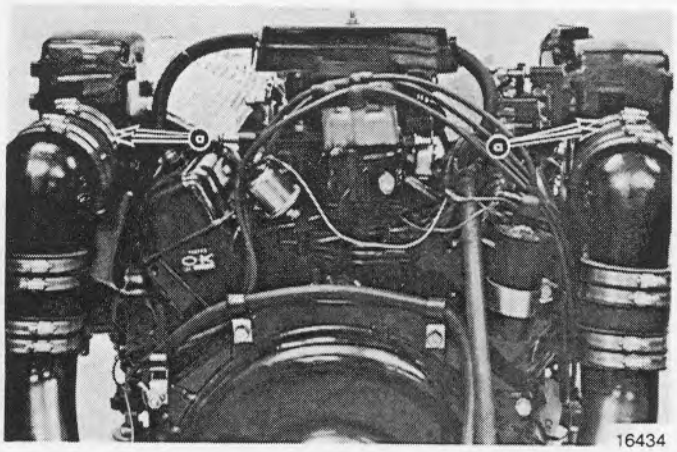
IMPORTANT: Fluid Mount Only — You MUST use wrench on mount stud wrench-flat, to prevent twisting and damaging internal components of the mount, whenever adjustments, loosening, or tightening are performed. DO NOT turn (reposition) base of mount without locknut "a" being loose.



a - Locknut and Lockwasher
b - Adjustment Nut
c - Turn Adjustment Nut in this Direction (Counterclockwise) to Raise Front of Engine
d - Slotted Hole Toward Front of Engine. Attach Mounts to Stringers, Using 3/8 in. (9mm) Lag Bolts
e - Tab Washer

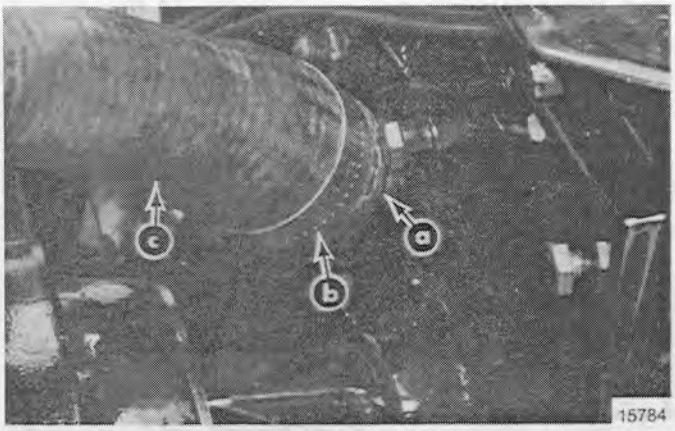
IMPORTANT: Refer to "Alignment" before proceding.

7. Install exhaust bellows to exhaust elbows and secure with clamps. Tighten securely.



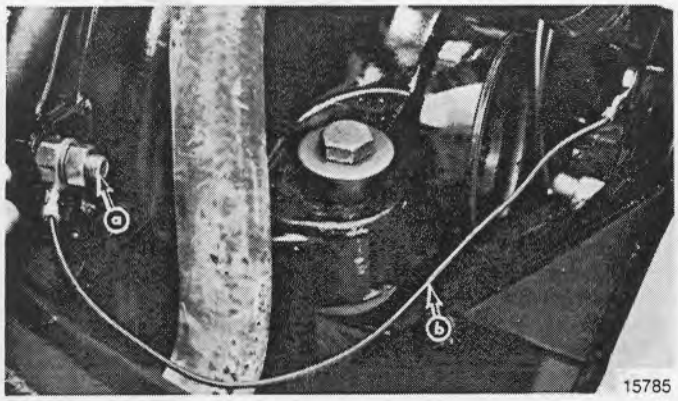
a - Clamps

8. Attach water inlet hose to water tube, secure with hose clamp, tighten securely.



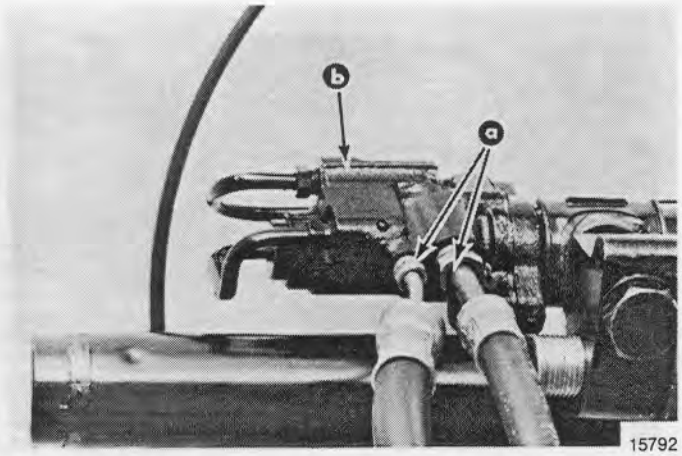
a - Water Tube
b - Hose Clamp
c - Inlet Hose

9. Connect ground wire. Tighten securely.



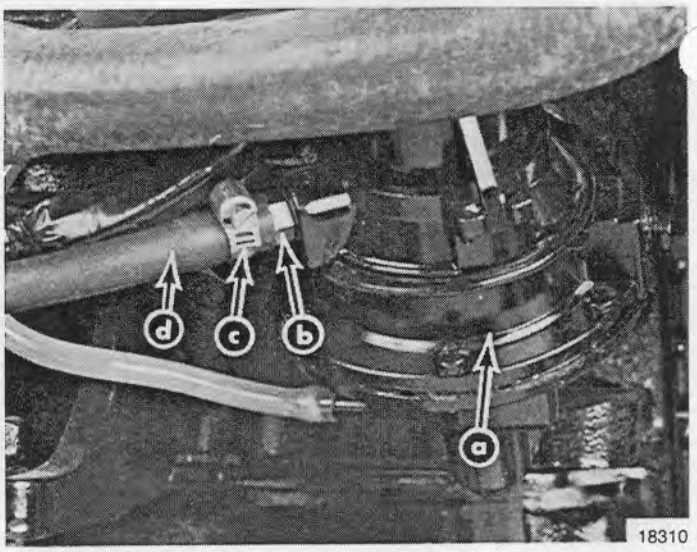
a - Flywheel Housing Stud
b - Ground Wire

10. Connect power steering lines to power steering unit and tighten to specifications.



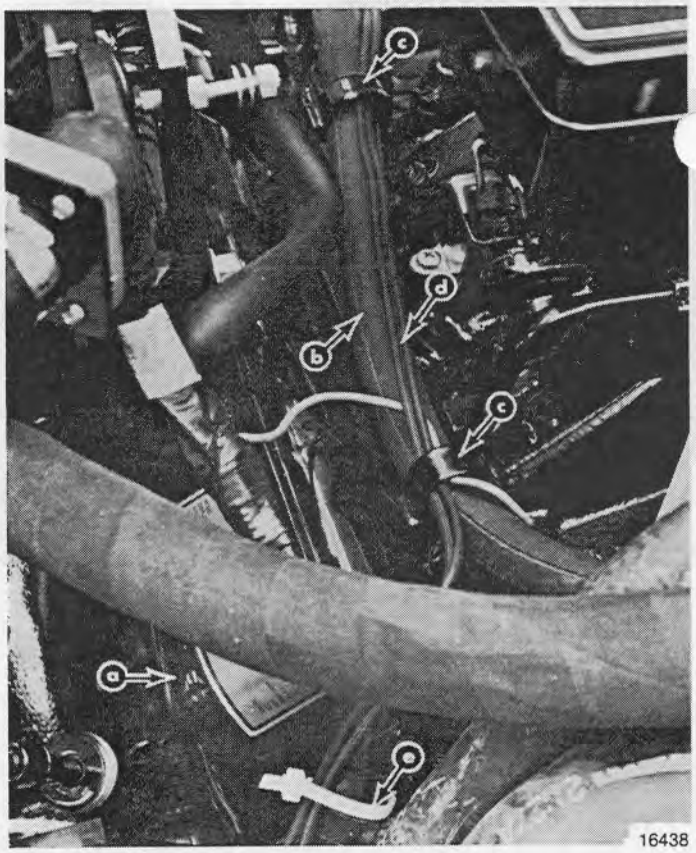
a - Power Steering Lines
b - Power Steering Unit

11. Install fuel line to fuel pump inlet, torque fitting to specifications and tighten clamp securely.

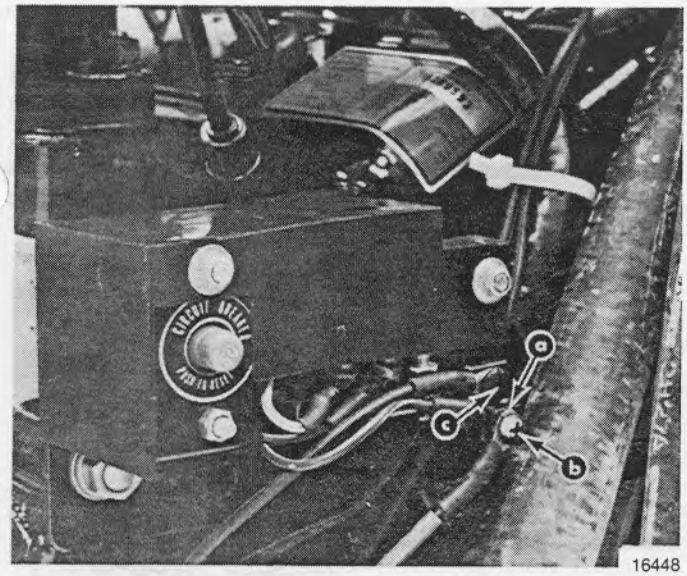


a - Fuel Pump
b - Fitting
c - Clamp
d - Fuel Line

12. Connect power trim position sender wires.



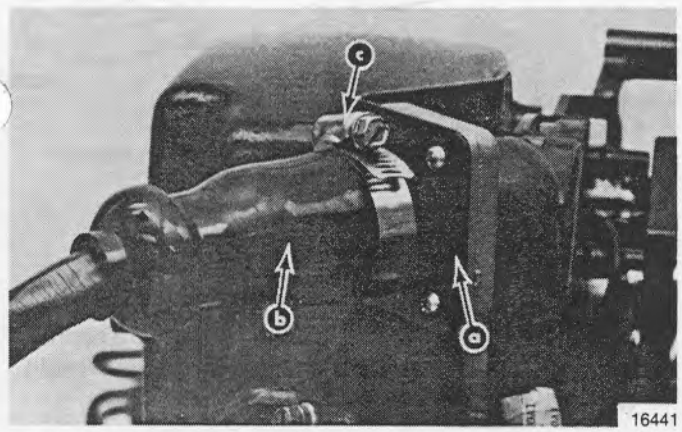
a - Starboard Rocker Arm Cover
b - Power Steering Hydraulic Hose
c - Hose Clips
d - **Earlier Models** — Trim Position Sender Leads (Route Thru Hose Clips along with Power Steering Hydraulic Hose)
Later Models — Trim Position Leads are at the rear of the engine
e - Sta-Strap Leads at This Location



16448

a - Terminal Block
b - Connect Trim Position Sender Lead with Brown or Purple Sleeve to Terminal On Terminal Block to Which Brown/White Lead is Already Attached
c - Connect Trim Position Sender Lead without Sleeve to Terminal Block Mounting Screw

13. Plug in wiring harness and secure with hose clamp. Tighten clamp securely.

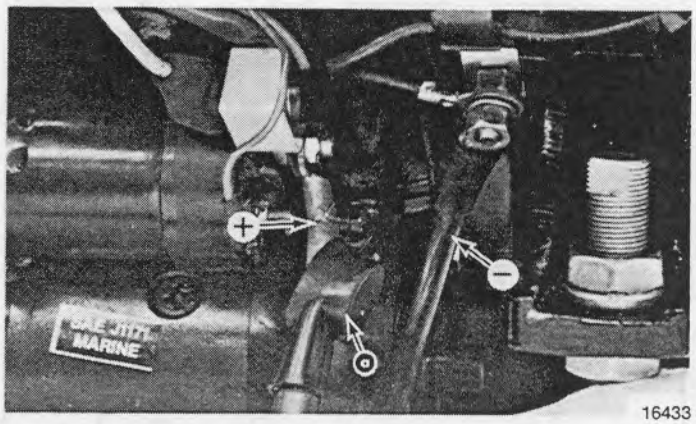


16441

a - Wiring Harness Bracket
b - Wiring Harness Plug
c - Hose Clamp

14. Reconnect any ground or accessory wires that have been removed.

15. Connect battery cables to starter and ground. Tighten securely and cover starter connection with rubber boot.



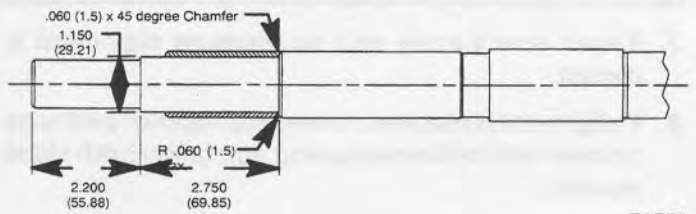
16433

a - Rubber Boot

16. Connect cables to battery and tighten securely.

Alignment

To ensure more engine coupler engagement modify alignment tool as shown.

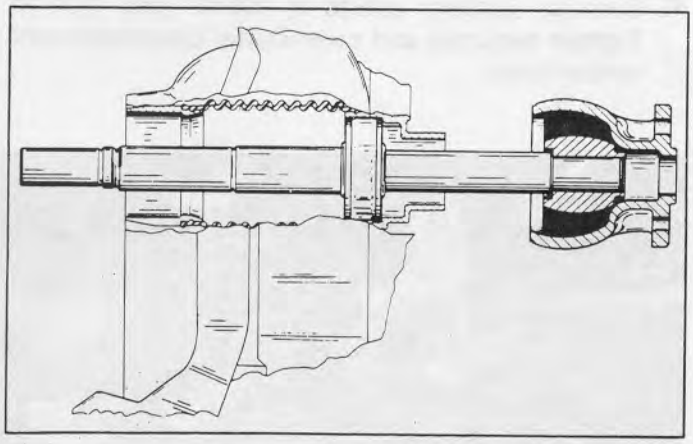


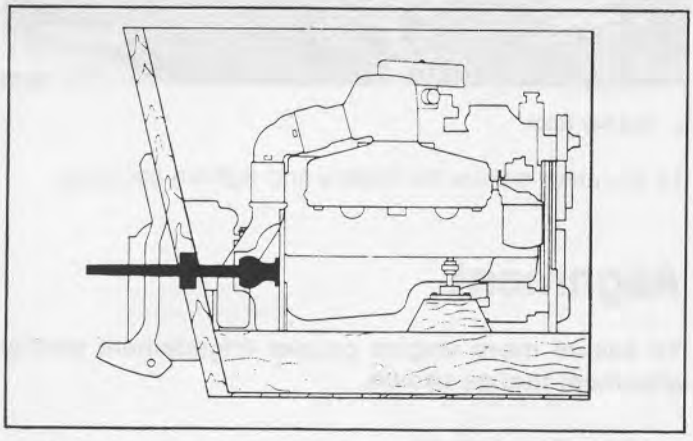
71551

a - To Engine Coupling

IMPORTANT: DO NOT remove more than .560" from gimbal bearing area of alignment tool. This .560" dimension ensures that the gimbal bearing will straddle the existing "under cut" in alignment tool.

1. Insert alignment tool into and thru gimbal bearing and into engine coupling.

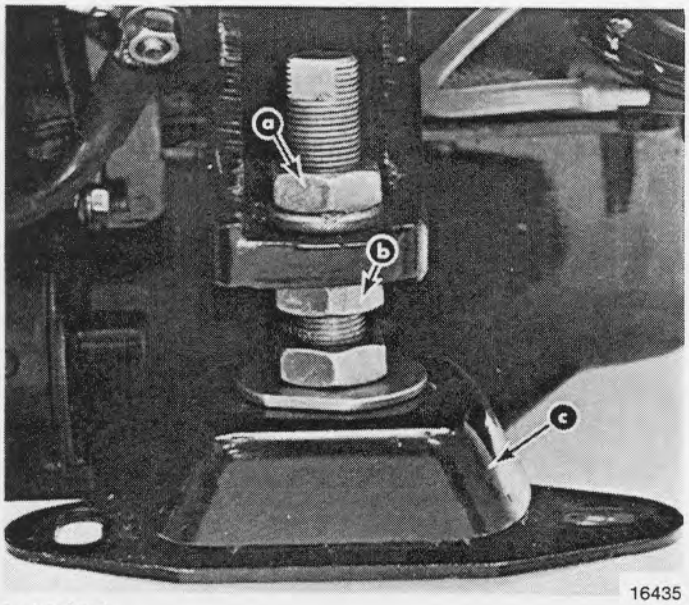




2. If shaft enters freely with no pressure alignment is correct.

3. If alignment is required, loosen top locknut and raise or lower with bottom adjusting nut, (align both sides equally).

RUBBER FRONT MOUNT

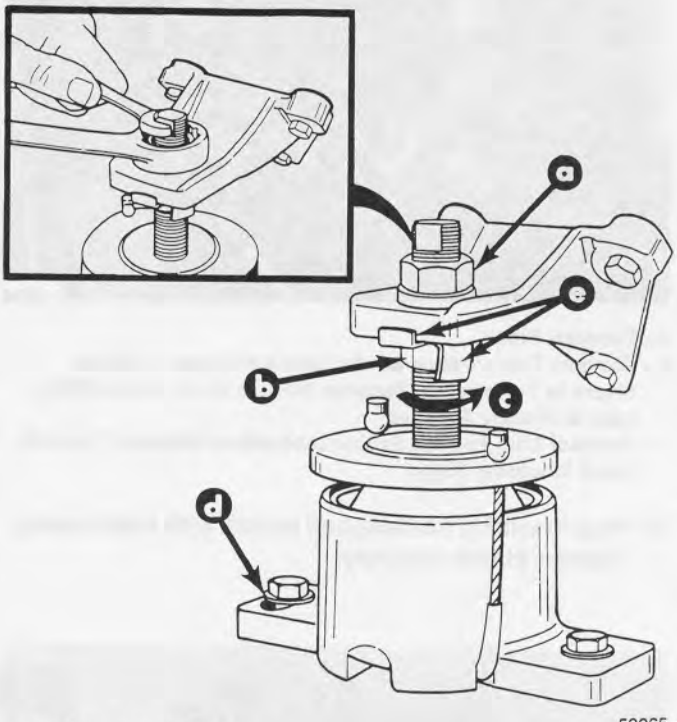


16435

a - Locknut
b - Adjusting Nut
c - Engine Mount

FLUID FRONT MOUNT

IMPORTANT: Fluid Mount Only — You MUST use wrench on mount stud wrench-flat, to prevent twisting and damaging internal components of the mount, whenever adjustments, loosening, or tightening are performed. DO NOT turn (reposition) base of mount without locknut "a" being loose.



50065

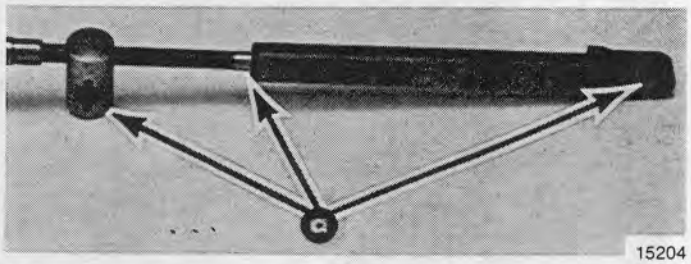
a - Locknut and Lockwasher
b - Adjustment Nut
c - Turn Adjustment Nut in this Direction (Counterclockwise) to Raise Front of Engine
d - Slotted Hole Toward Front of Engine. Attach Mounts to Stringers, Using 3/8 in. (9mm) Lag Bolts
e - Tab Washer

4. With alignment correct retighten nuts and recheck alignment. Tighten securely — while holding wrench-flat at top of mount stud.

IMPORTANT: If alignment is part of reinstallation, support engine by center lifting eye (on thermostat housing) to ensure that side to side height adjustment is correct BEFORE FINAL ALIGNMENT.

Attaching and Adjusting Throttle Cable

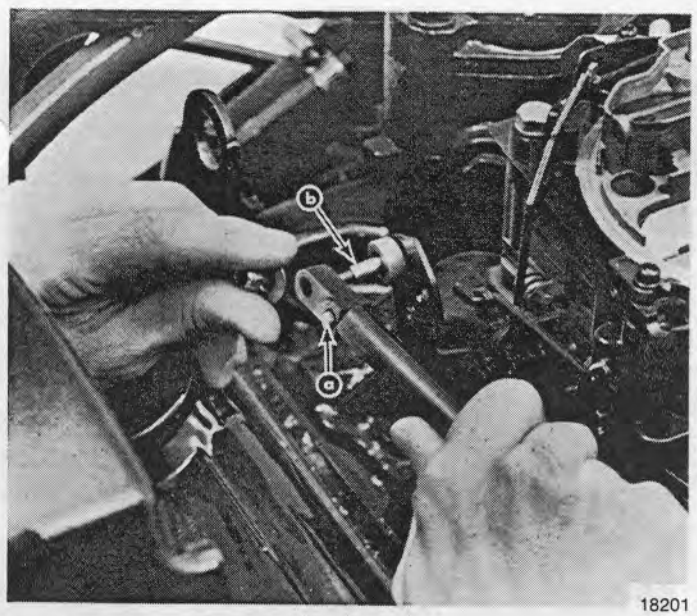
1. Lubricate cable ends (shift and throttle) with SAE Grade Motor Oil, at locations shown.



a - Lubricate

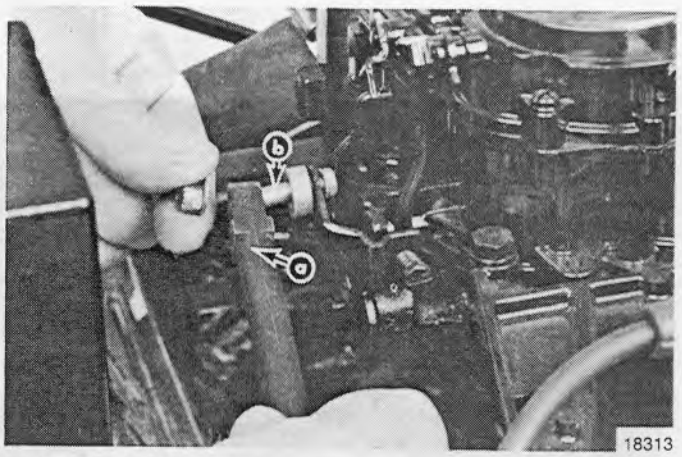
2. Place remote control in neutral.
3. Lubricate anchor stud at carburetor with SAE Grade Motor Oil.
4. Install cable end guide, flat washer and stop nut onto anchor stud and tighten to specifications.

4 BARREL



a - Cable End Guide
b - Anchor Stud

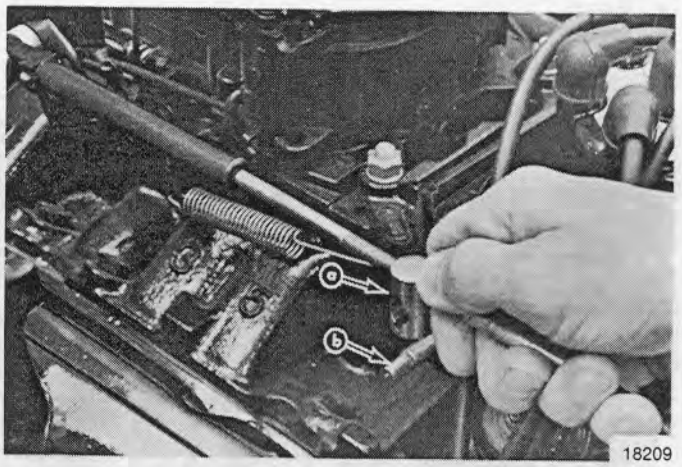
2 BARREL



a - Cable End Guide
b - Anchor Stud

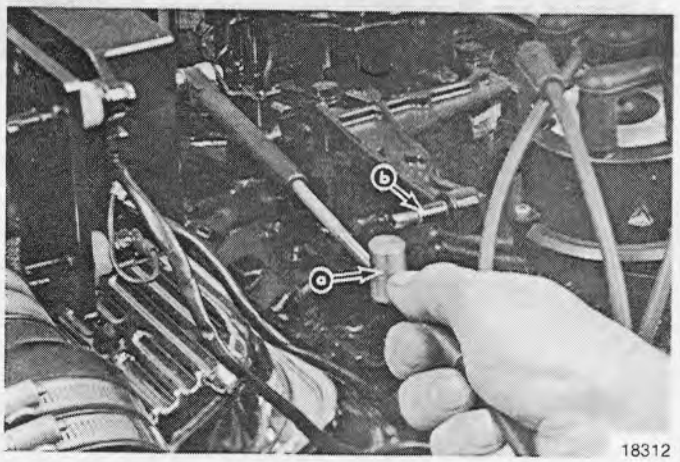
5. Grasp cable behind cable barrel and push lightly to align barrel to stud.

4 BARREL



a - Barrel
b - Stud

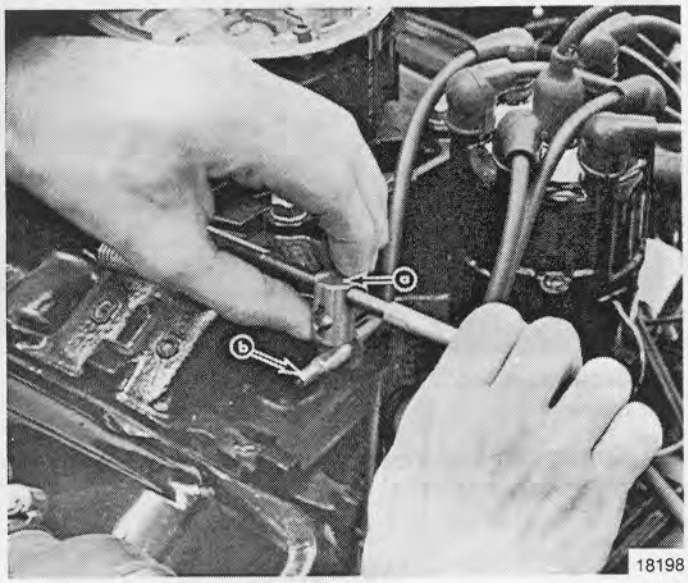
2 BARREL



a - Barrel
b - Stud

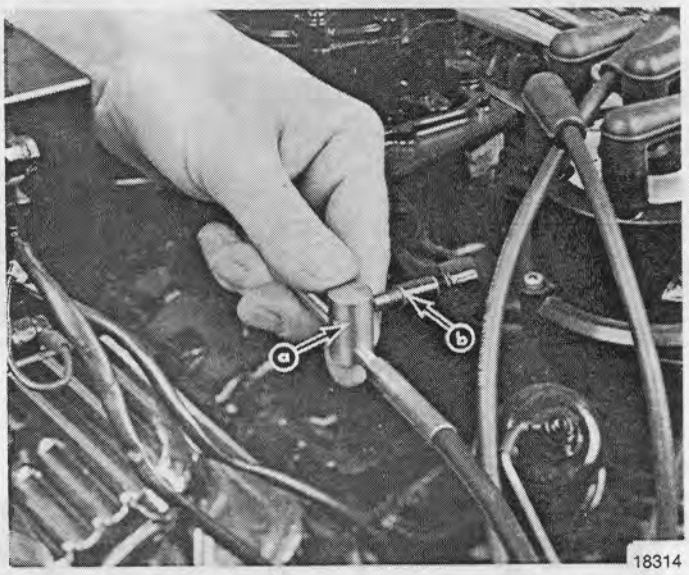
6. Turn barrel to align with stud.

4 BARREL



a - Barrel
b - Stud

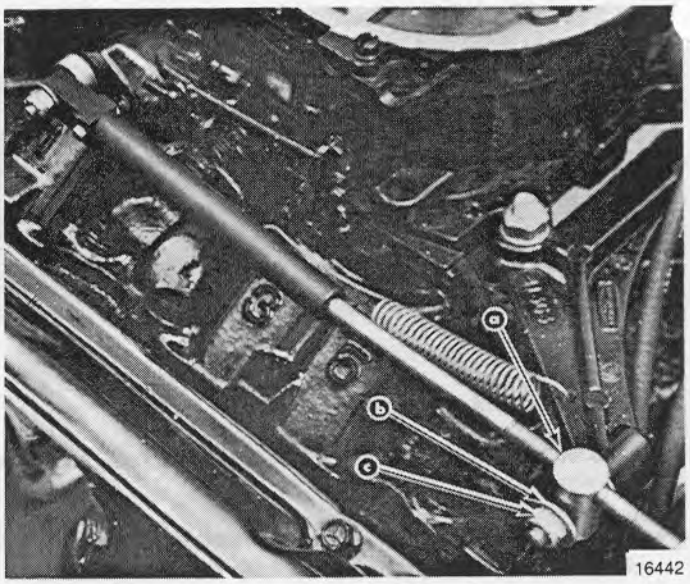
2 BARREL



a - Barrel
b - Stud

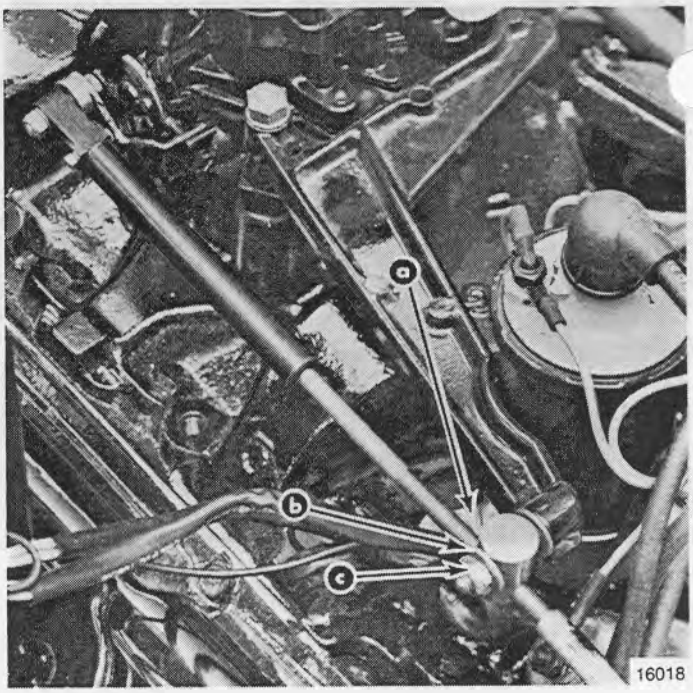
7. Secure cable barrel to stud with flat washer and locknut. Position barrel as shown.

4 BARREL



a - Cable Barrel
b - Washer
c - Locknut

2 BARREL



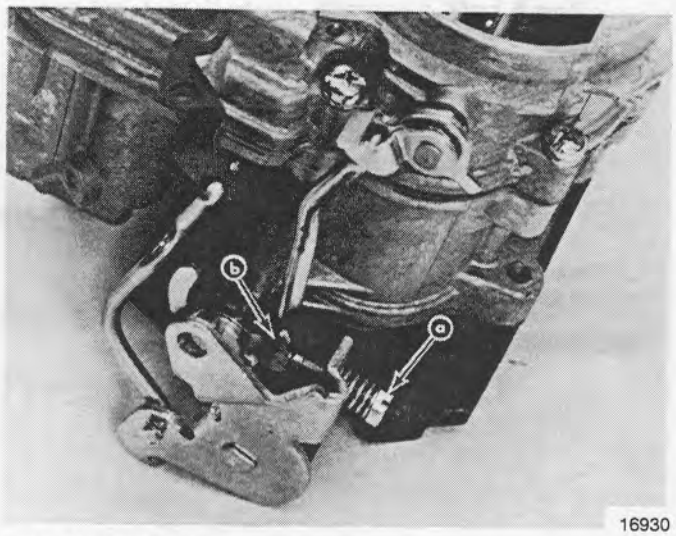
a - Cable Barrel
b - Washer
c - Locknut

8. Shift to neutral, throttle plates must be completely closed.
9. Throttle linkage tang must contact idle speed adjustment screw.

ROCHESTER 4 BARREL

a - Throttle Linkage Tang
b - Idle Speed Screw

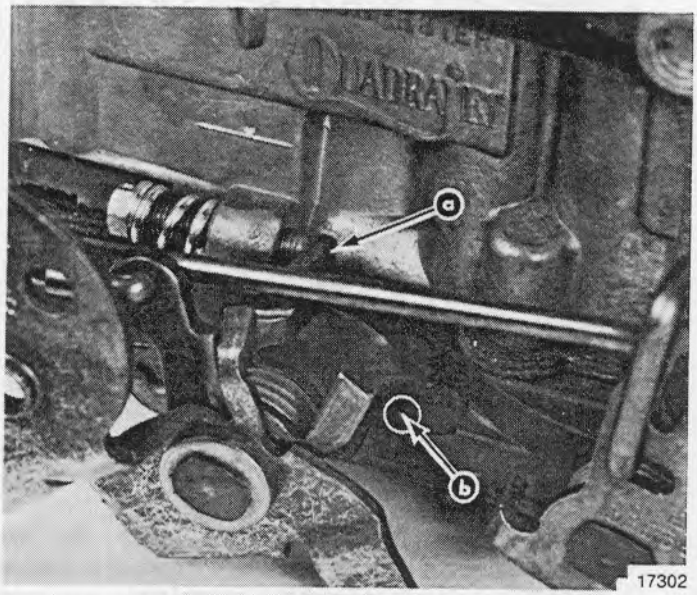
2 BARREL



a - Idle Speed Screw
b - Idle Cam

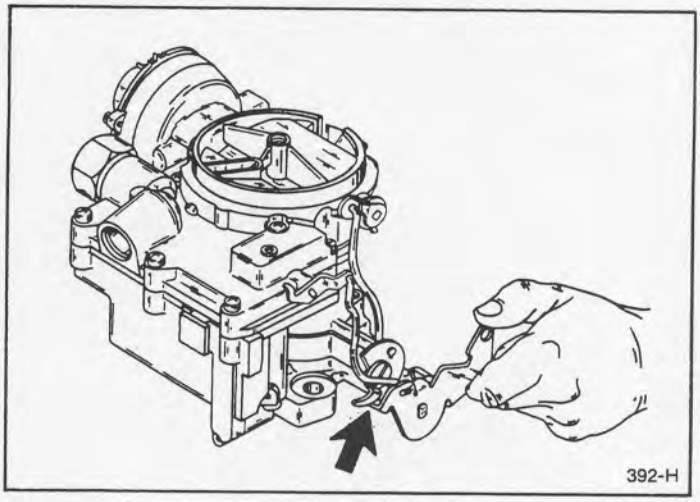
10. Shift to full throttle. Throttle plates must be completely open.
11. Throttle linkage tang must make contact where shown.

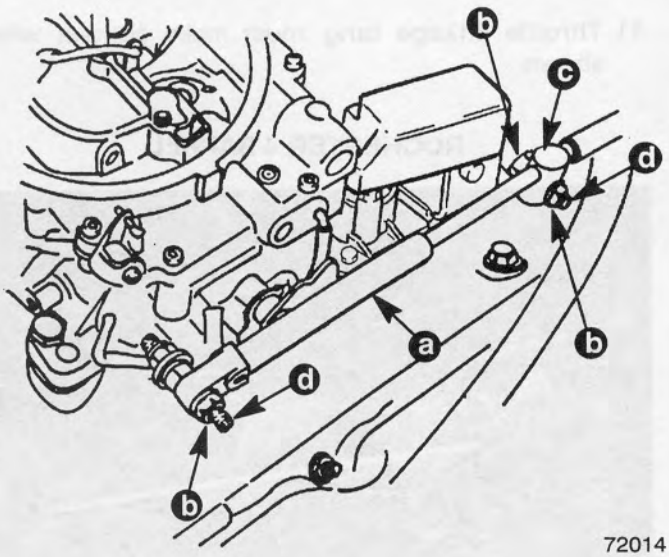
ROCHESTER 4 BARREL



a - Throttle Linkage Tang
b - Contact Point

2 BARREL



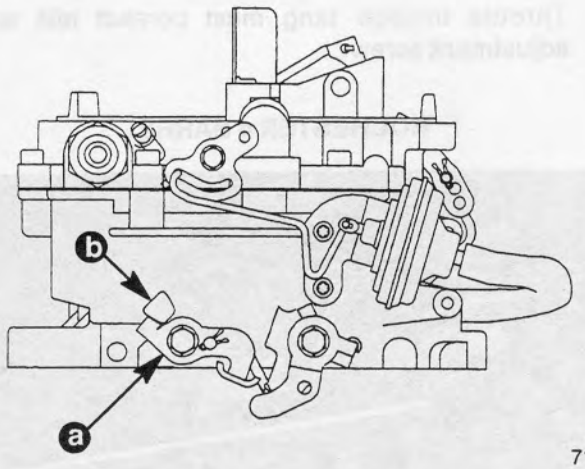


72014

a - Cable End Guide
b - Attaching Hardware
c - Cable Barrel
d - Anchor Studs

1. Place remote control throttle lever in the wide-open-throttle (W.O.T.) position. Check to ensure that throttle shutters (valves) are completely open and throttle shaft lever contacts carburetor body casting.
2. Return remote control throttle lever to idle position and check to ensure that throttle lever contacts idle speed adjustment screw.

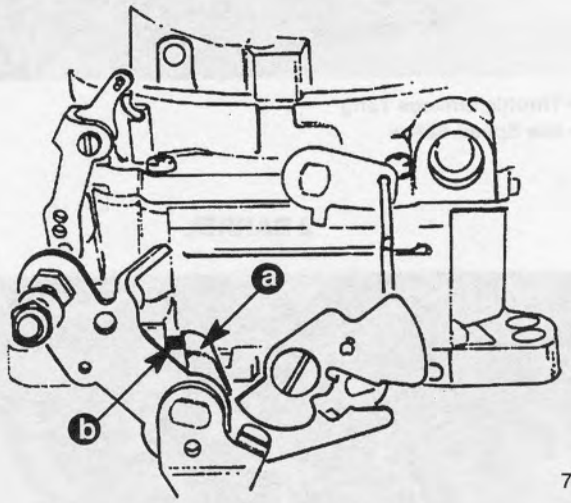
WEBER 4 BARREL CARBURETOR



71159

a - Throttle Shaft Lever [Contacts (b) at W.O.T. Position]
b - Carburetor Body Casting

Wide-Open-Throttle Position



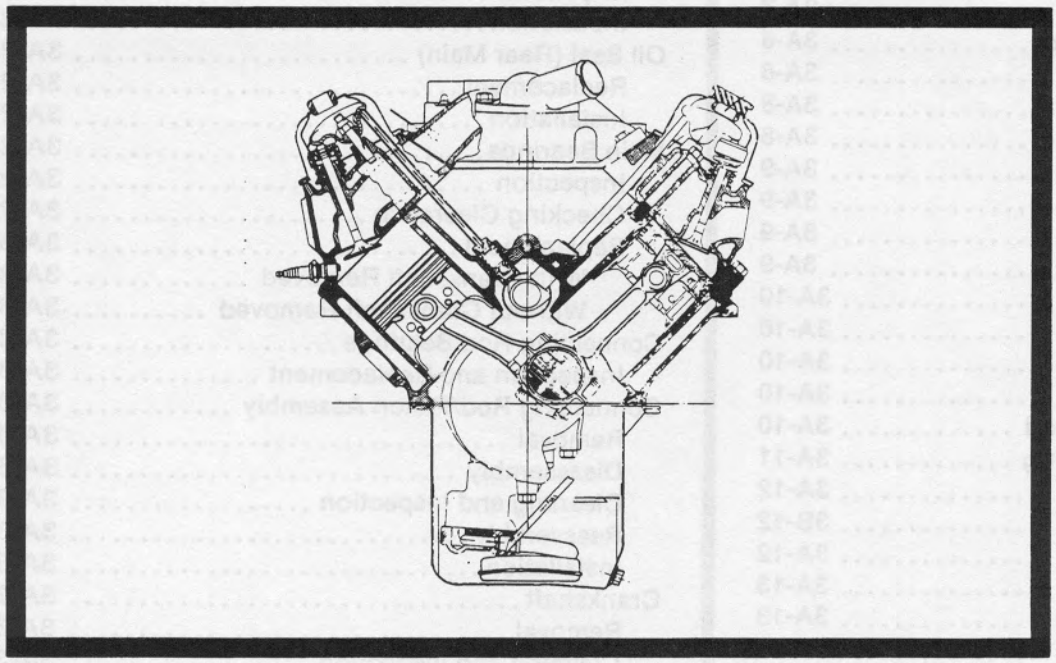
70392

a - Throttle Lever [Contacts (b) in Idle Position]
b - Idle Speed Adjustment Screw

Idle Position

ENGINE MECHANICAL

3
A



V-6 GM (229 CID 3.8 LITRE)

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Torque Specifications

Fastener Location	Lbs. Ft. (N.m)	Lbs. In. (N.m)
Camshaft Sprocket	20 (27)	
Conn. Rod Cap	45 (61)	
Crankcase Front Cover		80 (9)
Cylinder Head	65 (88)	
Distributor Clamp	20 (27)	
Exhaust Manifold	20 (27)	
Flywheel/Coupler	40 (54)	
Flywheel Housing	30 (41)	
Intake Manifold	30 (41)	
Main Bearing Cap	70 (95)	
Oil Filter	25 (34)	
Oil Filter By-Pass Valve		80 (9)
Oil Pan to Crankcase (5/16-18)		165 (19)
Oil Pan to Crankcase (1/4-20)		80 (9)
Oil Pan Drain Plug	20 (27)	
Oil Pump	65 (88)	
Oil Pump Cover		80 (9)
Rocker Arm Cover		45 (5)
Spark Plug		180 (20)
Torsional Damper	60 (81)	
Water Pump	30 (41)	

Special Tools

MERCURY MARINE SPECIAL TOOLS	
91-35547	Engine Coupler Wrench
91-66273	Rocker Stoppers
91-24697	Piston Ring Expanders

KENT-MOORE SPECIAL TOOLS Can be ordered from: Kent-Moore Tools, Inc. 29784 Little Mack Roseville, MI 48066 Phone: (313) 774-9500	
J-8062	Valve Spring Compressor (Cylinder Head Off)
J-8101	Valve Guide Bore Cleaning Brush
J-8358	Valve Seat & Valve Face Cleaning Brush
J-5830-1	Oversize Valve Guide Reamer (.003")
J-5830-6	Oversize Valve Guide Reamer (.006")
J-9345-1	Oversize Valve Guide Reamer (.010")
J-8080	Crankshaft Upper Bearing Shell Remover & Installer
J-8369	Oil Suction Pipe Installer
J-5825	Crankshaft Sprocket Remover
J-5239	Connecting Rod Guide Set for Cap Screw Rods
J-5802-01	Rocker Arm Stud Remover
J-6880	Rocker Arm Stud Installer
J-5590	Crankshaft Sprocket Installer
J-8037	Piston Ring Compressor
J-25087	Oil Pressure Gauge
J-3049	Valve Lifter Remover
J-5790	Hydraulic Valve Lifter Leakdown Tester
J-23394	Front Intake Manifold Bolt Wrench
J-5250	Timing Chain Cover Oil Seal Installer
J-4160-A	Hydraulic Valve Lifter Plunger Remover
J-5892	Valve Spring Compressor (Cylinder Head on Block)
J-8089	Carbon Removing Brush
J-6098	Camshaft Bearing Remover and Installer
J-8056	Valve Spring Tester
J-23994	Valve Seal Leak Tester
J-8520	Cam Lobe Lift Indicator
J-24086-20	Piston Remover Base
J-24086-8	Piston Pin Remover
J-24086-9	Piston Pin Installer
J-22509	Intake Valve Seal Installer

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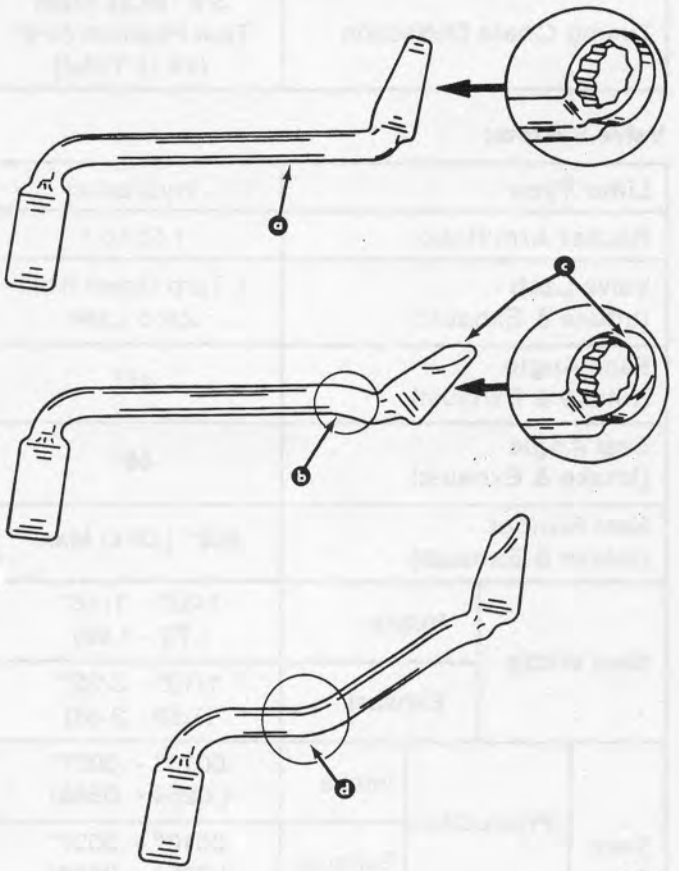
LUBRICANTS - SEALERS	
92-823089-1	Loctite 8831
92-34227-1	Quicksilver Perfect Seal
92-825265A1	Quicksilver Needle Bearing Assembly Lubricant
92-91601-1	Quicksilver RTV Sealer

Engine Coupler Wrench, 91-35547, may not work on the later couplers. Modify wrench as shown so it will work on both earlier and later style couplings.



230-H

a - Original 91-35547 Wrench
b - Heat and Bend as Shown
c - Grind Area Shown Slightly
d - Heat and Bend as Shown (This is what wrench should look like when it's done)

Engine Specifications

Model	185R
Displacement	229 (3.8 Liter)
Engine Type Number of Cylinders	V-6

Cylinder Bore: inches (mm)

Diameter			3.7350" - 3.7385" (94.8690-94.9579)
Out of Round	Production		.001" (.025) Max.
	Service		.002" (.051) Max.
Taper	Production	Thrust Side	.0005" (.0127) Max.
		Relief Side	.001" (.025) Max.
	Service		.001" (.025) Max.

Piston:

Clearance	Production	.0007" - .0017" (.0178 - .0432)
	Service	.0027" (.0686) Max.

Piston Ring: **(1) HI Production Limit**

Compression	Groove Side Clearance	Production	Top	.0012" - .0032" (.0305 - .0813)
			2nd	.0012" - .0032" (.0305 - .0813)
		Service		(1) + .001" (.025)
	Gap	Production	Top	.010" - .020" (.254 - .508)
			2nd	.010" - .025" (.254 - .635)
		Service		(1) + .010" (.254)
Oil	Groove Side Clearance	Production		.002" - .007" (.051 - .178)
		Service		(1) + .001" (.025)
	Gap	Production		.015" - .055" (.381 - 1.397)
		Service		(1) + .010" (.254)

Piston Pin:

Diameter		.9270" - .9273" (23.5458 - 23.5534)
Clearance	Production	.00025" - .00035" (.00635 - .00889)
	Service	.001" (.025) Max.
Fit in Rod		.0008" - .0016" (.0203 - .0406) Interference

Crankshaft:

Main Journal	Diameter	No. 1	2.4484" - 2.4493" (62.1894 - 62.2122)
		No. 2, 3	2.4481" - 2.4490" (62.1817 - 62.2046)
		No. 4	2.4479" - 2.4488" (62.1767 - 62.1995)
	Taper	Production	.0002" (.0051) Max.
		Service	.001" (.025) Max.
	Out of Round	Production	.0002" (.0051) Max.
		Service	.001" (.025) Max.
Main Bearing Clearance	Production	No. 1	.0008" - .0020" (.0203 - .0508)
		No. 2, 3	.0011" - .0023" (.0279 - .0584)
		No. 4	.0017" - .0032" (.0432 - .0813)
	Service	No. 1	.001" - .0015" (.0254 - .0381)
		No. 2, 3	.001" - .0025" (.0254 - .0635)
		No. 4	.0025" - .0035" (.0635 - .0889)
Crankshaft End Play			.002" - .006" (.051 - .152)
Connecting Rod Journal	Diameter		2.0986" - 2.0998" (53.3095 - 53.3349)
	Taper	Production	.0005" (.0127) Max.
		Service	.001" (.025) Max.
	Out of Round	Production	.0005" (.0127) Max.
		Service	.001" (.025) Max.
Rod Bearing Clearance		Production	.0013" - .0035" (.0330 - .0889)
		Service	.003" (.0762) Max.
Rod Side Clearance			.008" - .014" (.203 - .356)
Crankshaft Runout			.0015" (.0381) Max.

Camshaft and Drive:

Lobe Lift ±.002" (.051mm)	Intake	.357" (9.0678)
	Exhaust	.390" (9.906)
Journal Diameter		1.8682" - 1.8692" (47.452 - 47.478)
Journal Out-of-Round		.001" (.025) Max.
Camshaft End Play		.004" - .012" (.102 - .304)
Timing Chain Deflection		3/8" (9.5) From Taut Position [3/4" (19.1) Total]

Valve System:

Lifter Type			Hydraulic
Rocker Arm Ratio			1.50 to 1
Valve Lash (Intake & Exhaust)			1 Turn Down from Zero Lash
Face Angle (Intake & Exhaust)			45°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			.002" (.051) Max.
Seat Width		Intake	1/32" - 1/16" (.79 - 1.59)
		Exhaust	1/16" - 3/32" (1.59 - 2.38)
Stem Clearance	Production	Intake	.0010" - .0027" (.0254 - .0686)
		Exhaust	.0010" - .0027" (.0254 - .0686)
	Service	Intake	.0037" (.0940)
		Exhaust	.0047" (.1194)
Valve Spring	Free Length		2.03" (51.6)
	Pressure Lbs. @ In. (NOTE 1)	Closed @ 1.70" (43.16)	76 - 84 Lbs. (34.5 - 38.1kg)
		Open @ 1.25" (31.75mm)	194 - 206 Lbs. (88.1 - 93.5kg)
	Installed Height		1-23/32" (43.7)
Damper	Free Length		1.86" (47.24)
	Approximate No. of Coils		4

Cylinder Head:

Gasket Surface Flatness	.003" (.076) 6" (15.24cm) .007" (.178) Overall Maximum

Flywheel:

Runout	.008" (.203) Max.

NOTE 1: Check with damper removed.

General

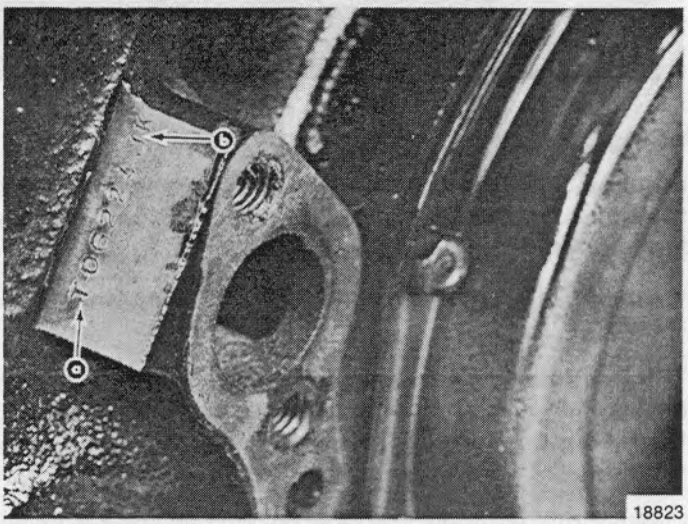
Some repairs, that are listed in this section, must be completed with engine removed from boat. Engine removal depends upon type of repair and boat design. Place engine on repair stand for major repairs.

Lubricate all moving parts (during reassembly) with engine oil. Apply Perfect Seal on threads of and under head of cylinder head bolts and on threads of all cylinder block external bolts, screws and studs.

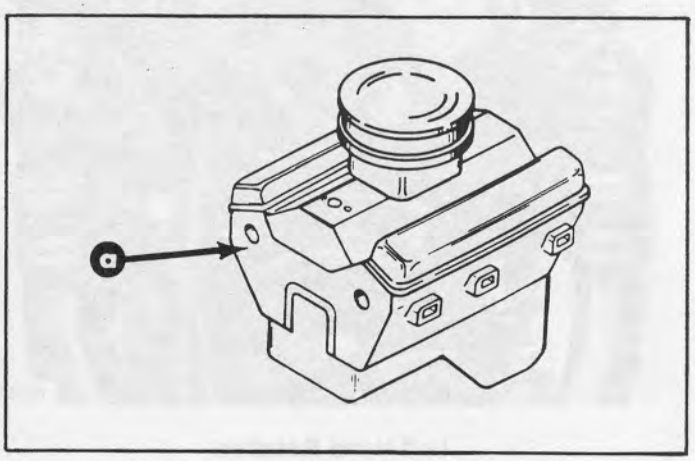
ENGINE IDENTIFICATION

The MerCruiser Model can be determined by looking at the last two letters of the engine code stamped into the cylinder block. This code number is stamped on all MerCruiser Power Packages and replacement partial engines but not replacement cylinder block assemblies.

If the engine serial number, and/or model decals are missing, the engine code letters may help in determining the engine model.

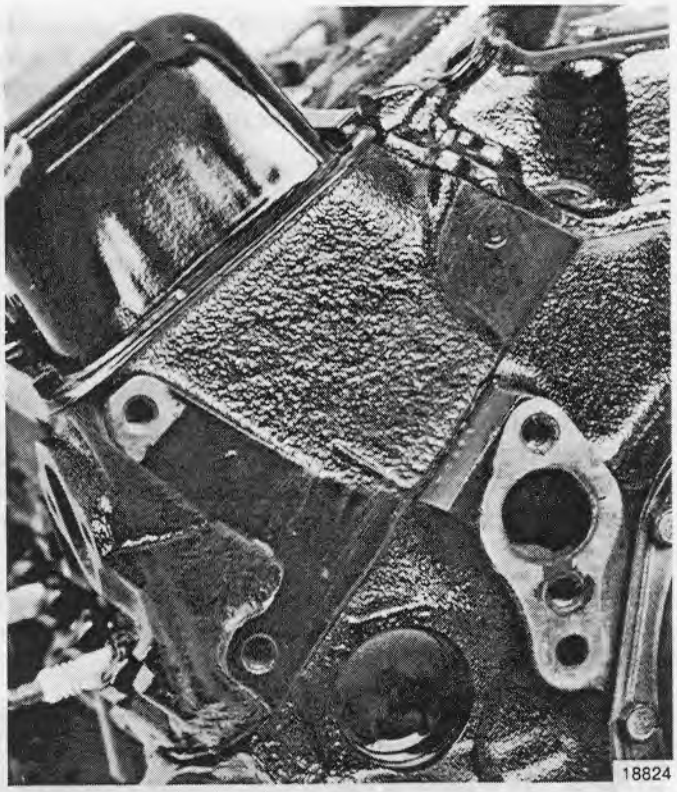


a - Engine Code
b - Last Two Letters - JK = MCM 185 (229 CID)



a - Front, Starboard Side, Near Cylinder Head Mating Surfaces

CYLINDER HEAD IDENTIFICATION

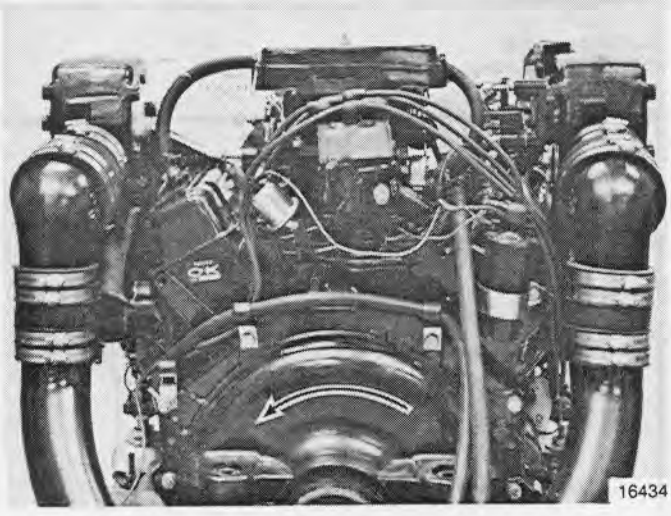


MCM 185R (229 CID) ENGINE ROTATION

Engine rotation is determined by observing flywheel rotation from the rear (stern drive end) of the engine looking forward (water pump end).

Propeller rotation is not necessarily the same as engine rotation.

When ordering replacement engines, short blocks or parts for engines, be certain to check engine rotation. Do not rely on propeller rotation in determining engine rotation.



Left Hand Rotation

CRANKSHAFT

The crankshaft is supported in the block by four insert type bearings. Crankshaft end thrust is controlled by flanges on the number four bearing. A torsional damper on the forward end of the crankshaft serves to help dampen any engine torsional vibration.

PISTON and CONNECTING RODS

Piston pins are offset slightly toward the thrust side of the pistons to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins have a floating fit in the piston and a press fit in the connecting rod.

Connecting rods are made of forged steel and are connected to the crankshaft thru insert type bearings.

CAMSHAFT and DRIVE

Camshaft is supported by four bearings, which are pressed into the block, and is driven at one-half crankshaft speed by a timing chain and sprockets.

Taper on lobes coupled with spherical foot on hydraulic valve lifters, causes the valve lifters to rotate, thus reducing wear. A helical gear on the aft end of the camshaft drives the distributor and oil pump, while an eccentric cam on the front of the camshaft actuates the fuel pump.

CYLINDER HEAD

The cylinder heads are made of cast iron and have individual intake and exhaust ports for each cylinder.

Stainless steel head gaskets are used to retard corrosion.

VALVE TRAIN

The valves and valve springs are of a heavy-duty design to withstand the high engine speeds encountered. Valve tips have been hardened to extend valve life. Exhaust valve rotators are used to help extend valve life.

Hydraulic valve lifters ride directly on the camshaft lobes and transmit the thrust of the lobes to the push rods which in turn actuate the valves thru the rocker arm.

In addition to transmitting thrust of the cam lobes, the hydraulic lifters also serves to remove any clearance (lash) from the valve train to keep all parts in constant contact.

The valve lifters also are used to lubricate the valve train bearing surfaces.

INTAKE MANIFOLD

The manifold is of the single level design. All passages are of approximately equal length to assure more even fuel-air mixture to the cylinders.

LUBRICATION SYSTEM

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rods, camshaft bearings and valve lifters, and is supplied under controlled volume to the push rods and rocker arms. All other moving parts are lubricated by gravity flow or splash.

A positive displacement gear-type oil pump is mounted on the rear main bearing cap and is driven by an extension shaft from the distributor (which is driven by the camshaft). Oil from the bottom of the pump in the rear of the oil pan is drawn into the oil pump through an oil pickup screen and pipe assembly.

Once the oil reaches the pump, the pump forces the oil thru the lubrication system. A spring loaded relief valve in the pump limits the maximum pump output pressure.

After leaving the pump, the pressurized oil flows thru a full-flow oil filter.

Some of the oil, after leaving the oil cooler and/or filter, is routed to the No. 4 crankshaft main bearing. The remainder of the oil is routed to the main oil gallery, which is located above the camshaft and runs the entire length of the block. From the main oil gallery, the oil is routed thru individual oil passages to an annular groove in each camshaft bearing bore. Some of the oil is then used to lubricate camshaft bearings. The remainder of the oil is routed to the valve lifter oil galleries and No. 1, 2, and 3 crankshaft main bearings by means of individual oil passages which intersect with the annular grooves.

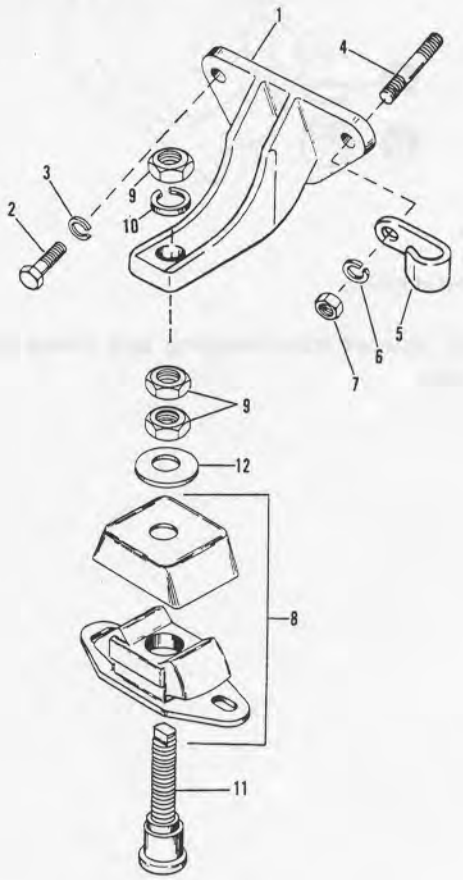
The camshaft bearings have holes which align with the oil passages or annular grooves in the block and allow oil to flow in between the bearings and the camshaft journals. The oil that is forced out the front end of the No. 1 camshaft bearing drains down onto camshaft drive and keeps it lubricated.

The oil which reaches the crankshaft main bearings is forced thru a hole in the upper half of each bearing and flows in-between the bearings and the crankshaft journals. Some of the oil is then routed to the connecting rod bearings thru grooves in the upper half of the crankshaft main bearings and oil passages in crankshaft. Oil which is forced out the ends of the connecting rod bearings and crankshaft main bearings is splashed onto the camshaft, cylinder walls, pistons and piston pins, keeping them lubricated. Oil which is forced out the front end of the No. 1 crankshaft main bearing also assists in lubricating the camshaft drive.

Oil which reaches the valve lifters oil galleries is forced into each hydraulic valve lifter thru holes in the side of the lifter. From here, the oil is forced thru the metering valve in each of the lifters (which controls the volume of oil flow) and then up thru the push rods to the rocker arms. A hole in each rocker arm push rod seat allows the oil to pass thru the rocker arm and lubricate the valve train bearing surfaces. After lubricating valve train, oil drains back to the oil pan thru oil returns holes in the cylinder head and block.

The distributor shaft and gear also is lubricated by the oil flowing thru the right valve lifter oil gallery. Fuel pump push rod is lubricated by oil thrown off from the camshaft eccentric.

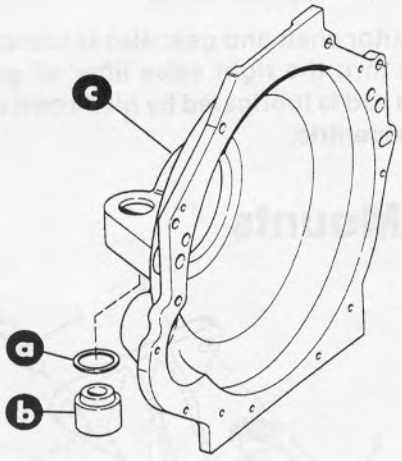
Front Mounts



1	BRACKET	
2	SCREW (1-1/4")	Port
3	LOCKWASHER	Port
2	SCREW (1-3/8")	Port
3	WASHER	Port
2	SCREW (1-1/4")	Starboard
3	LOCKWASHER	Starboard
4	STUD	Starboard
5	CLIP	Starboard
6	LOCKWASHER	Starboard
7	NUT	Starboard
8	BASE	
9	NUT	
10	LOCKWASHER	
11	STUD	
12	WASHER	

Rear Mounts/Flywheel Housing

1. Inspect mounts for tears in rubber bonding to metal.
2. If mount must be replaced, press mounts out and retain spacer.



a - Spacer
b - Mount
c - Flywheel Housing

3. Install spacer into housing and press mount into housing.

Rocker Arm Cover

REMOVAL

It may be necessary to remove exhaust manifold before removing rocker arm cover. Also remove any component that will interfere with the removal of the manifold or rocker arm cover.

1. Remove rocker arm cover attaching hardware.
2. Disconnect crankcase ventilation hoses.

IMPORTANT: DO NOT pry rocker arm cover loose. Gaskets, which adhere to cylinder head and rocker arm cover, may be sheared by bumping end of rocker arm cover from the rear with palm of hand or a rubber mallet.

3. Remove rocker arm cover.

INSTALLATION

1. Clean sealing surfaces on cylinder head and rocker arm cover with degreaser.
2. Install rocker arm covers, as follows:
   a. Place new rocker arm cover gasket in position in rocker arm cover.
   b. Install rocker arm cover and secure with reinforcements and attaching nuts. Torque to 45 lbs. in.
3. Reinstall exhaust manifolds, if removed.
4. Reinstall any items which were removed from exhaust elbows to allow removal of rocker arm covers.
5. Connect crankcase ventilation hoses to valve rocker arm covers.
6. Start engine and check for oil leaks.

Intake Manifold

REMOVAL

1. Drain engine cooling system.
2. Disconnect hoses from thermostat housing.
3. Disconnect crankcase ventilation hoses from rocker arm covers.
4. Disconnect throttle cable from carburetor. Remove fuel line running between fuel pump and carburetor.

IMPORTANT: DO NOT crank engine over after distributor has been removed.

5. Remove distributor cap and mark position of rotor on distributor housing. Also, mark position of distributor housing on intake manifold. Remove distributor.
6. Remove other ignition components.
7. Disconnect wire from oil pressure sending unit and remove sending unit.
8. Disconnect any other items that will prevent removal of manifold.

IMPORTANT: It may be necessary to pry intake manifold away from cylinder heads and block, in next step. Use extreme care to prevent damage to sealing surfaces.

9. Remove intake manifold screws, then remove intake manifold and carburetor assembly.

NOTE: If intake manifold requires replacement, transfer carburetor and other related parts to new manifold.

CLEANING and INSPECTION

1. Clean gasket material from all mating surfaces.

IMPORTANT: When cleaning cylinder head mating surface, do not allow gasket material to enter engine crankcase.

2. Inspect manifold for cracks or scratches. Machined surfaces must be clean and free of all marks, or deep scratches or leaks may result.
3. Check intake passages for varnish buildup or other foreign material. Clean as necessary.

INSTALLATION

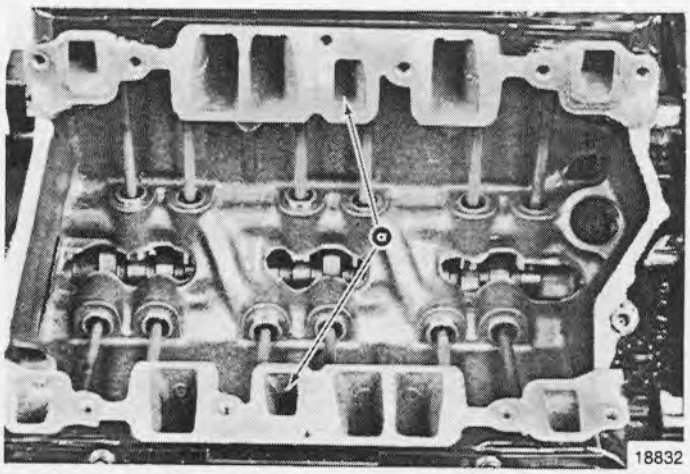
IMPORTANT: When installing intake manifold gaskets, in next step, be sure to do the following: Be sure to install gasket with marked side up. Both gaskets are identical.

1. Apply Perfect Seal to intake manifold gaskets and install gaskets on cylinder heads.
2. Place a 3/16" (5mm) wide bead of RTV sealer on block. Extend the bead 1/2" (13mm) up each gasket to seal corners.

a - RTV Sealer (Typical Both Ends)

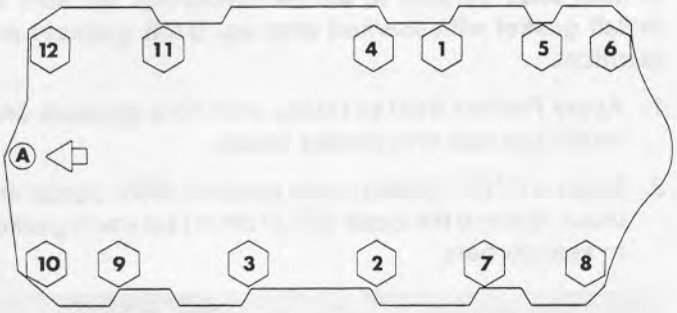
IMPORTANT: All MerCruiser V-6 G.M. engines that have "automatic" carburetor chokes must use an intake gasket that has an opening for the exhaust crossover port in the intake manifold.

Without this opening the "automatic" choke will not operate properly. The choke will remain "on" longer causing rough engine operation and wasted fuel.



a - Exhaust Crossover Port Opening

3. Carefully install manifold assembly and torque bolts to 30 lbs. ft. (40.7 N.m) in sequence.



a - Front

4. Connect wire to water temperature sending unit.
5. Reconnect hoses to thermostat housing, tighten securely.
6. Install fuel line to carburetor and fuel pump. Torque to 18 lb. ft. (24 N·m).
7. Connect throttle cable to carburetor.
8. Connect crankcase ventilation hoses to rocker arm covers.
9. Install distributor. Position rotor and housing to align with marks made during removal. Tighten securely, then install distributor cap.
10. Install other ignition components and reconnect wires.
11. Coat threads of oil pressure sending unit with Perfect Seal and install.
12. Connect wire to sending unit.
13. Reconnect any other items which were disconnected from manifold during the removal.
14. Start engine. Adjust ignition timing and carburetor. Check hose connections, gaskets and seals for leaks.
15. Inspect fuel line connections for fuel leaks.

Rocker Arm/Push Rod

REMOVAL

1. Remove rocker arm covers.
2. Remove rocker arm components, rocker arms and push rods.

IMPORTANT: Place rocker arms, rocker arm components and push rods in a rack for reinstallation in the same locations.

CLEANING and INSPECTION

1. Clean parts with solvent and dry with compressed air.
2. Inspect all contact surfaces for wear. Replace all damaged parts.

INSTALLATION

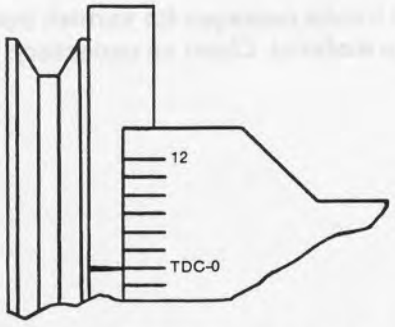
IMPORTANT: When installing rocker arms and rocker arm balls, coat bearing surfaces of rocker arms and rock arm balls with engine oil.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.
3. Valve lash can be adjusted either with engine stopped or running.

ADJUSTMENT - ENGINE STOPPED

With valve cover removed, adjust valves when lifter is on low part of camshaft lobe, as follows:

1. Crank engine with starter or turn over in normal direction of rotation until mark on torsional damper lines up with center "O" mark on timing tab, and engine is in No. 1 firing position. This may be determined by placing fingers on No. 1 valve as mark on damper comes near "O" mark on timing mark. If valves move as mark comes up to timing tab, engine is in No. 6 firing position and should be turned over one more time to reach No. 1 position.



2. With engine in No. 1 firing position, as determined above, the following valves may be adjusted.

Exhaust - 1, 5, 6
Intake - 1, 2, 3

3. Back out adjusting nut until lash is felt at push rod, then turn in adjusting nut until all lash is removed. This can be determined by moving push rod up-and-down while turning adjusting nut until all play is removed.

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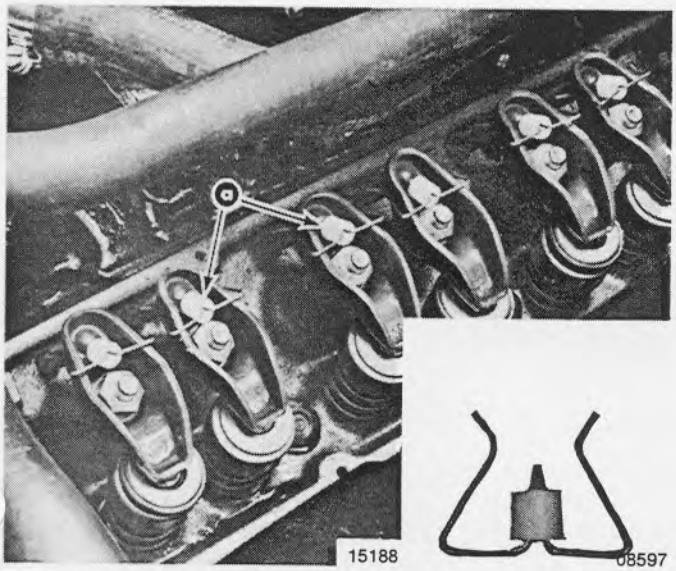
4. Hydraulic lifters now can be adjusted by tightening adjustment nut an additional 1-turn. No other adjustment is required.
5. Crank engine one revolution until pointer "O" mark and torsional damper mark are again in alignment. This is No. 6 firing position. With engine in this position, the following valves may be adjusted as previously outlined.

   Exhaust - 2, 3, 4
   Intake - 4, 5, 6

6. Install rocker arm covers.

ADJUSTMENT - ENGINE RUNNING

1. After engine has reached normal operating temperature, remove valve covers and install rocker stoppers.



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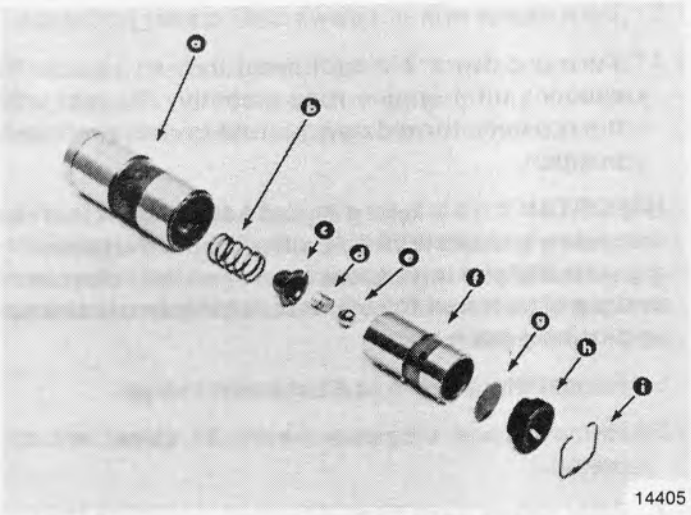
a - Rocker Stoppers

2. With engine running at idle, back rocker arm nuts off (one at a time) until valve rocker arm starts to clatter.
3. Turn rocker arm nut down until clatter just stops.
4. Turn nut down 1/4 additional turn and pause 10 seconds until engine runs smoothly. Repeat until nut has been turned down 1-turn from the zero lash position.

IMPORTANT: This 1-turn preload adjustment must be done slowly to allow lifter to adjust itself, thus preventing possibility of interference between inlet valve head and top of piston which might result in internal damage and/or bent push rods.

5. Repeat Steps 2-3-4 to adjust other valves.
6. Remove rocker stoppers after all valves are adjusted.
7. After valves have been adjusted, complete the following:
   a. Install new gasket and install covers. Torque to 45 lbs. in. (5.1 N.m).
   b. Adjust carburetor idle speed and mixture.
   c. Start engine and check for leaks.

Hydraulic Valve Lifters



a - Lifter Body
b - Plunger Spring
c - Check Ball Retainer
d - Check Ball Spring
e - Check Ball
f - Plunger
g - Metering Valve
h - Push Rod Seat
i - Push Rod Seat Retainer

Hydraulic Valve Lifter Assembly

Hydraulic valve lifters require little attention. Lifters are extremely simple in design. Normally, readjustments are not necessary and servicing requires only that care and cleanliness be exercised in the handling of parts.

LOCATING NOISY LIFTERS

Locate a noisy valve lifter by using a piece of garden hose approximately 4 ft. (1.2m) in length. Place one end of hose near end of each intake and exhaust valve, with other end of hose to the ear. In this manner, sound is localized, making it easy to determine which lifter is at fault.

Another method is to place a finger on face of valve spring retainer. If lifter is not functioning properly, a distinct shock will be felt when valve returns to its seat.

General type of valve lifter noise are as follows:

1. Hard rapping noise -- Usually caused by plunger becoming tight in bore of lifter body so that return spring cannot push plunger back up to working position. Probable causes are:
   a. Excessive varnish or carbon deposit, causing abnormal stickiness.
   b. Galling or "pick-up" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedged between plunger and lifter body.
2. Moderate rapping noise -- Probable causes are:
   a. Excessively high leakdown rate.
   b. Leaky check valve seat.
   c. Improper adjustment.
3. General noise throughout valve train -- This will, in most cases, be a definite indication of insufficient oil supply or improper adjustment.
4. Intermittent clicking -- Probable causes are:
   a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.
   b. In rare cases, ball itself may be out-of-round or have a flat spot.
   c. Improper adjustment.

In most cases, where noise exists in one or more lifters, all lifter units should be removed, disassembled, cleaned in solvent, reassembled and reinstalled in engine. If dirt, corrosion, carbon, etc, is shown to exist in one unit, it more likely exists in all the units, thus it would only be a matter of time before all lifters caused trouble.

REMOVAL

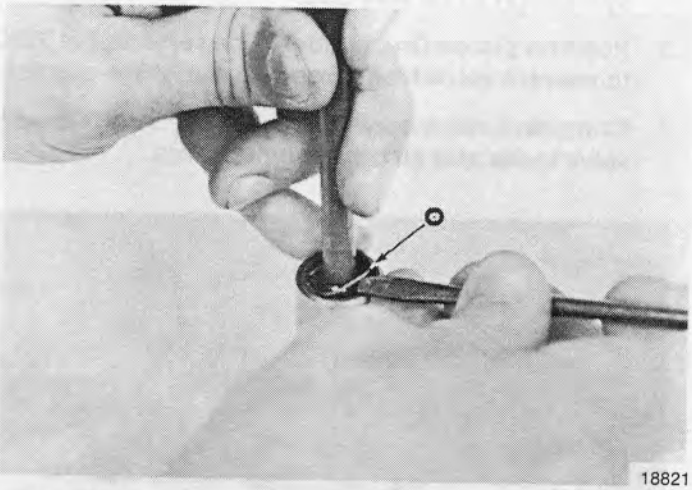
1. Remove intake manifold.
2. Remove valve mechanism.
3. Remove valve lifters.

IMPORTANT: Keep push rod and hydraulic valve lifter from each valve together as a matched set and mark them so they can reinstalled in the same location later.

DISASSEMBLY

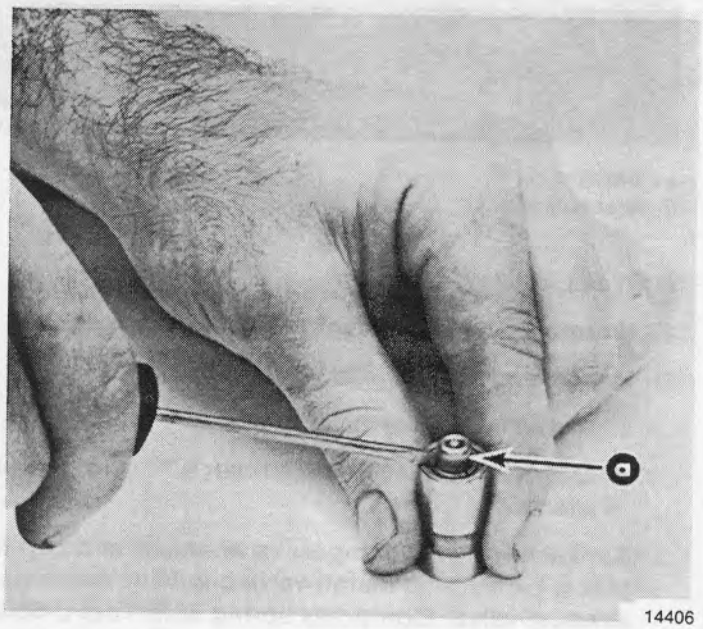
IMPORTANT: The internal parts of each hydraulic lifter assembly are matched sets. Do not intermix the PARTS.

1. Hold plunger down with a push rod and remove push rod seat retainer with the blade of a small screwdriver.



a - Seat Retainer

2. Remove push rod seat and metering valve.
3. Remove the plunger, and the plunger spring.
4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screwdriver.



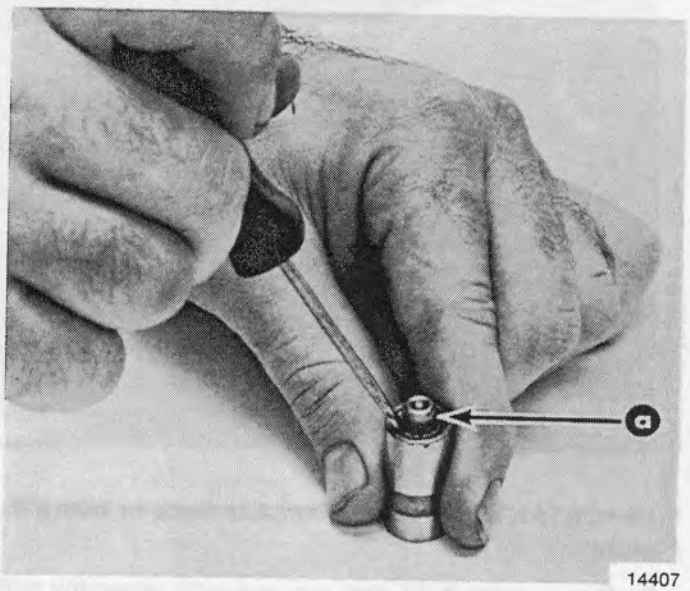
a - Check Ball Retainer

CLEANING and INSPECTION

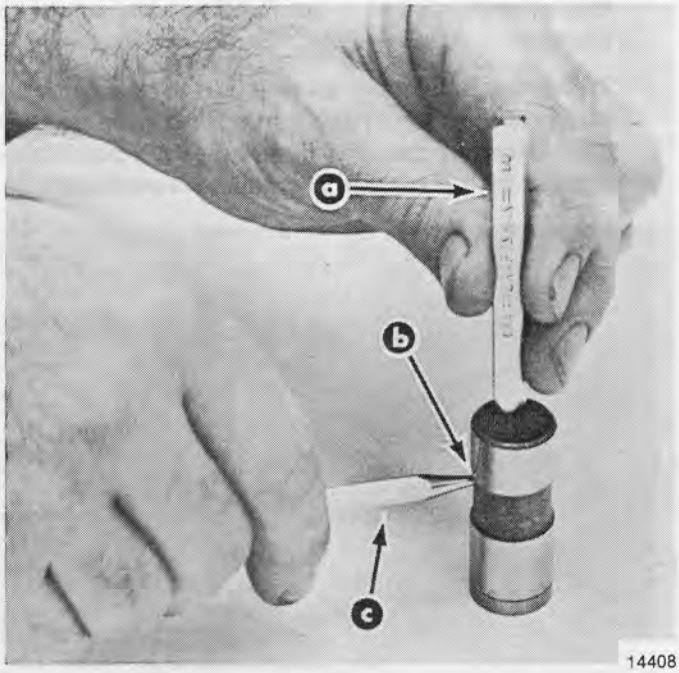
Thoroughly clean all parts in cleaning solvent and inspect them carefully. If any parts are damaged or worn, entire lifter assembly should be replaced. If outer lifter body wall is scuffed or worn, inspect cylinder block lifter bore. If bottom of lifter is scuffed or worn, inspect camshaft lobe. If push rod seat is scuffed or worn, inspect push rod.

REASSEMBLY

1. Place the check ball in small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screwdriver.



3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed hole in the lifter body and plunger.
4. Fill the assembly with oil, then insert the end of a 1/8" drift pin into the plunger and press down on check ball until hole in lifter body aligns with hole in plunger.
5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension.



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IMPORTANT: DO NOT attempt to force or pump the plunger.

6. Remove the 1/8" drift pin and refill assembly with oil.
7. Install the metering valve, push rod seat and push rod seat retainer.
8. Press down on the push rod seat with a push rod and remove 1/16" drift pin from lifter.

INSTALLATION

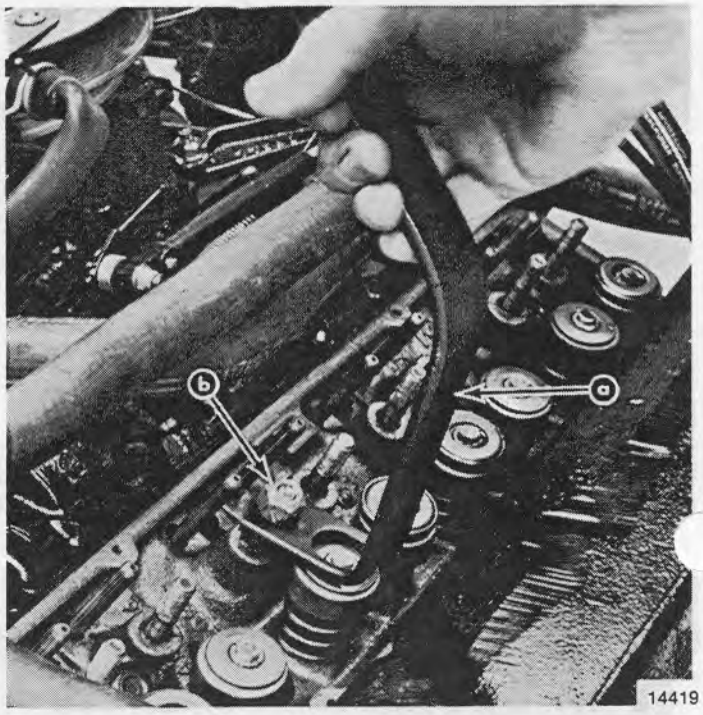
IMPORTANT: Before installing lifters, coat the bottom of the lifter with engine oil. If new lifters or a new camshaft has been installed, an additive containing EP lube (such as Quicksilver Engine Oil Supplement) should be poured over camshaft lobes before installing lifters.

1. Install hydraulic valve lifters.
2. Install intake manifold.
3. Install and adjust valve mechanism as outlined.
4. Install rocker arm cover.
5. Start engine and check for leaks.

Valve Stem Oil Seal Valve Spring

REMOVAL

1. Remove rocker arm cover.
2. Remove spark plug, rocker arm and push rod on cylinder(s) to be serviced.
3. Position piston (in cylinder to be serviced) at TDC, to prevent valve from dropping out of valve guide.
4. Compress valve spring with J-5892 Tool. Remove valve locks and all other components.



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a - J-5892 Tool
b - Rocker Arm Nut

INSTALLATION

1. If removed, install damper in valve spring.
2. If engine has additional valve stem seal:
   a. Install intake valve "O" ring seal.
   b. DO NOT install exhaust valve "O" ring seal, discard.
3. Set valve spring, damper, valve shield and cap in place. Be sure to install valve cap with rotator on exhaust valve. Compress spring with Tool J-5892 and install oil seal into lower groove of valve stem.

IMPORTANT: A light film of oil will help prevent twisting of the seal.

4. Install valve locks and release pressure of tool being sure that locks are in place. Grease may be used to help hold locks while removing pressure from tool.

Cylinder Head

REMOVAL

1. Drain engine cooling system.
2. Remove exhaust manifolds.
3. Remove intake manifold.
4. Remove valve mechanism.

NOTE: Remove any component attached to front or aft end of cylinder head to be removed.

5. Remove spark plugs.
6. Remove spark plug wire retainers from cylinder head.
7. Remove cylinder head bolts, cylinder head and gasket.
8. Place cylinder head on 2 blocks of wood to prevent damage.

CLEANING and INSPECTION

For cleaning and inspection, refer to "Cylinder Head and Valve Conditioning".

INSTALLATION

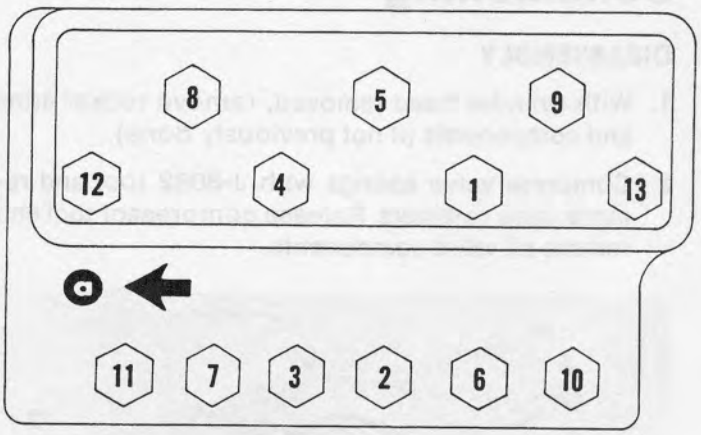
⚠CAUTION

Gasket surfaces on both head and block must be clean of any foreign matter and free of nicks or deep scratches. Cylinder bolt threads in block and threads on cylinder head bolts must be clean. (Dirt will affect bolt torque.)

1. Using a STAINLESS STEEL gasket, coat both sides of new gasket with Perfect Seal. Spread sealer thin and even. Too much sealer may hold gasket away from head or block. Using a fiber gasket no sealer is required.

IMPORTANT: Do not use a steel gasket.

2. Place gasket in position over dowel pins.
3. Carefully guide cylinder head into place over dowel pins and gasket.
4. Coat threads of cylinder head bolts with Perfect Seal and install bolts finger-tight.
5. Tighten each cylinder head bolt a little at a time in sequence shown. Torque to 65 lbs. ft. (88.1 N.m).



a - Front

6. Install exhaust manifolds as outlined.
7. Install intake manifold as described.
8. Install and adjust valve mechanism as outlined.
9. Install valve covers as outlined.
10. Install spark plugs. Torque to 180 lbs. in. (20.3 N.m).
11. Install spark plug wire retainers.

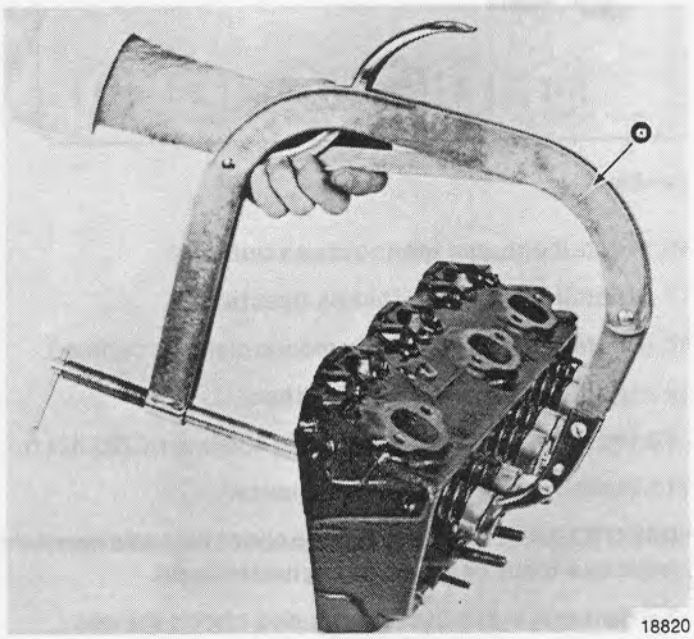
IMPORTANT: Install any component that was removed from the front or aft end of cylinder head.

12. Run engine, adjust timing and check for leaks.

Cylinder Head and Valve Conditioning

DISASSEMBLY

1. With cylinder head removed, remove rocker arms and components (if not previously done).
2. Compress valve springs with J-8062 tool and remove valve retainers. Release compressor tool and remove all valve components.

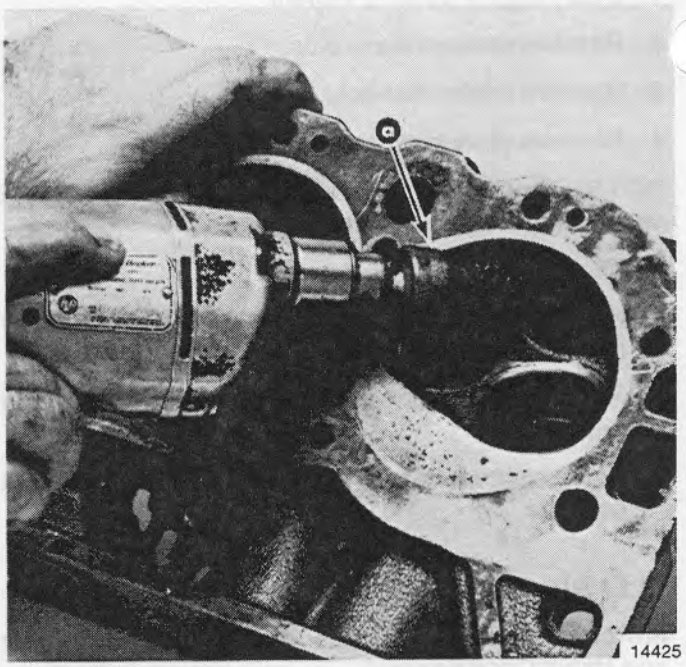


a - J-8062 Tool

3. Remove valves from cylinder head and place valves and components in a rack in their proper sequence for reassembly in their original positions.

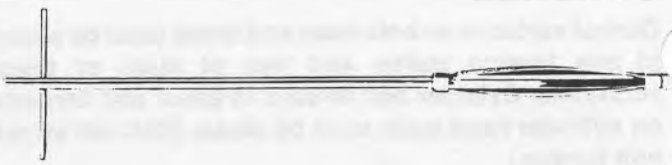
CLEANING

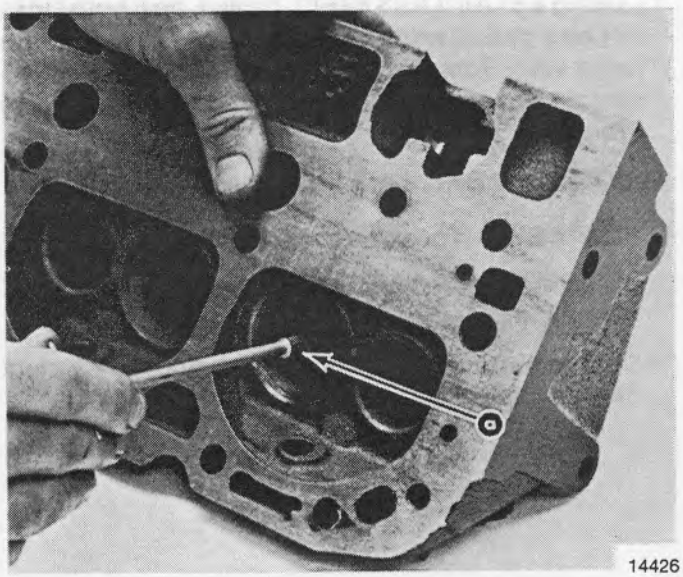
1. Clean all carbon from combustion chambers and valve ports with J-8089 tool.



a - J-8089 Tool

2. Thoroughly clean valve guides with J-8101 tool.



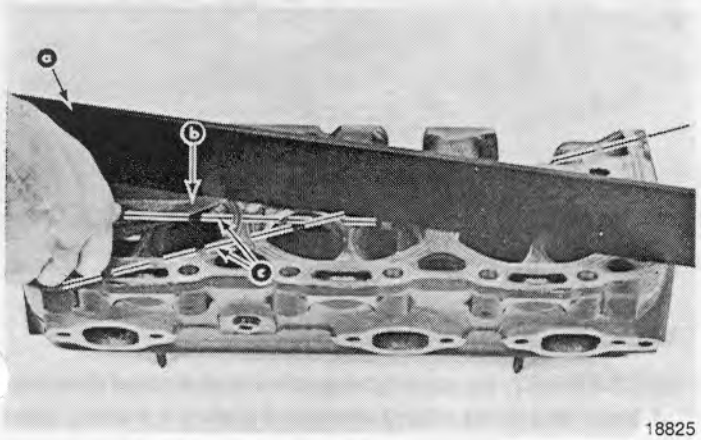


a - J-8101 Tool

3. Clean all push rods, rocker arms and push rod guides.
4. Clean carbon from valves on a buffing wheel.
5. Clean carbon deposits and gasket material from cylinder head mating surfaces.

INSPECTION

1. Inspect cylinder head for cracks in the exhaust ports, combustion chambers (especially around spark plug holes and valve seats) and for cracks in external surface of water jacket. Replace head if cracked.
2. Inspect cylinder head gasket surface for burrs, nicks, erosion or other damage. Also, check flatness of cylinder head gasket surface, using a machinists straight edge and feeler gauges as shown. Refer to "Specifications".



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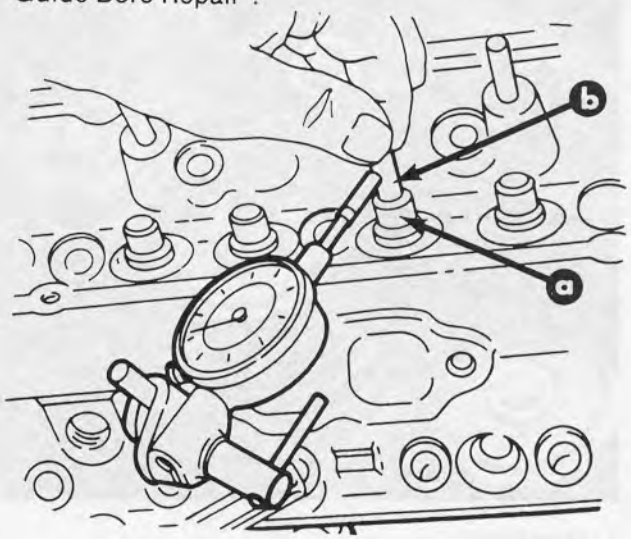
a - Straight Edge
b - Feeler Gauge
c - Take Measurements Diagonally Across Head (Both Ways) and Straight Down Center Head

IMPORTANT: Cylinder head to block gasket surface should be resurfaced if out-of-flat more than specified. When resurfacing gasket surface, cylinder head to intake manifold gasket surface also MUST BE milled to provide proper alignment between manifold and head.

3. Inspect valves for burned heads, cracked faces or damaged stems.

IMPORTANT: Excessive valve stem to bore clearance will cause excessive oil consumption and possible valve breakage. Insufficient clearance will result in noisy and sticky functioning of valve and disturb engine smoothness.

4. Measure valve stem clearance as follows: Clamp a dial indicator on one side of cylinder head rocker arm cover gasket rail, locating indicator so that movement of valve stem from side-to-side (crosswise to the head) will cause a direct movement of indicator stem. Indicator stem must contact side of valve stem just above valve guide. With valve head dropped about 1/16" (2mm) off valve seat, move valve stem from side-to-side, using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves, as outlined under "Valve Guide Bore Repair".



a - Valve Guide b - Valve Stem

5. Check valve spring tension with J-8056 spring tester.

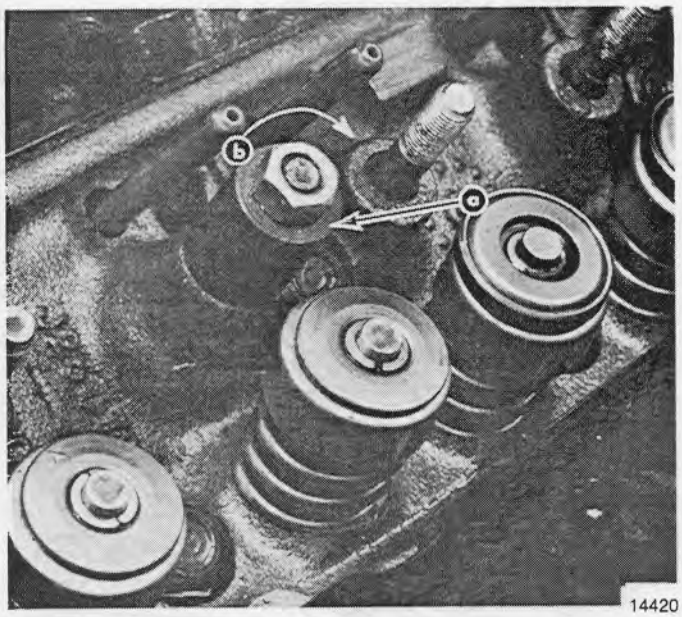
14429

IMPORTANT: Springs should be compressed to specified height and checked against specification. Springs should be replaced if not within 10 lbs. ft. (13.5 N.m) of specified load.

6. Inspect rocker arm studs for wear or damage. Inspect push rod guides for wear or damage.

ROCKER ARM STUDS and PUSH ROD GUIDE REPAIRS

1. Rocker arm studs, which are replaced because of wear or looseness, should be replaced with oversize studs.
2. a. Use Tool J-5802-01 to remove old stud by placing flat washer and nut over stud, then turning nut.



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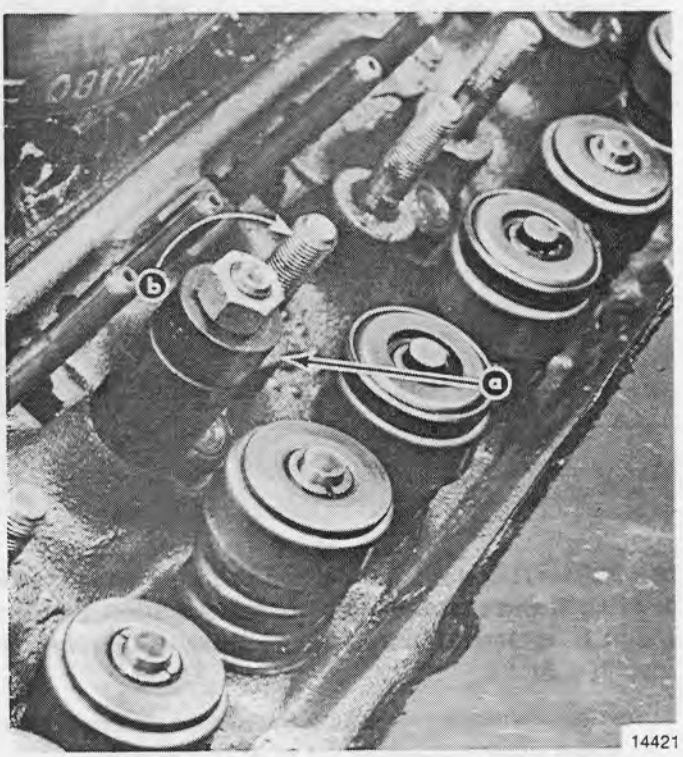
a - Large Sleeve
b - 3/8 x 24 Nut - Turn until Nut Bottoms Out on Stud Threads, Then Remove Nut

   b. Remove nut and washer and install second short spacer, washer and nut. Retighten nut until stud is removed.



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a - Install Small Sleeve
b - Turn Nut to Remove Stud

3. Ream stud hole, whenever installing an oversize stud, using appropriate reaming tool.
4. Install new stud with Tool J-6880 or similar stud installing tool made for press-in type studs. Follow instructions with tool.

14423

a - J-6880 Tool

VALVE GUIDE BORE REPAIR

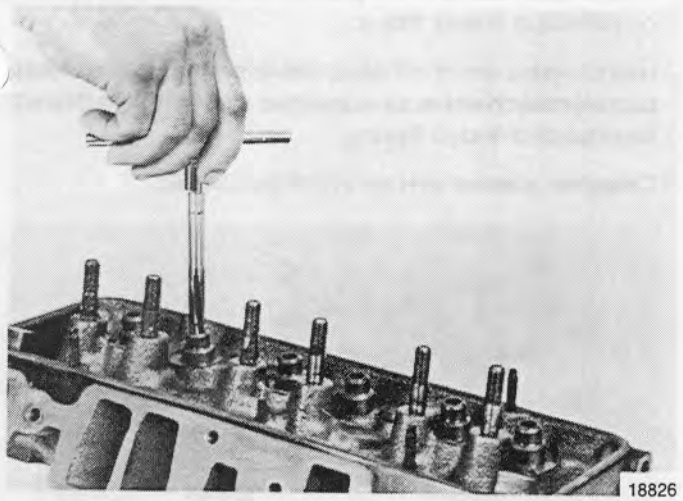
IMPORTANT: Be sure to measure valve stem diameter of both the intake and exhaust valve, as valve stem diameter may or may not be the same for both valves.

If .015" oversize valves are required ream valve guide bores for oversize valves, as follows:

1. Measure valve stem diameter of old valve being replaced and select proper size Valve Guide Reamer from chart below.

Standard Valve Stem Diameter	Reamer Required for Oversize Valve
.341	J-5830-2
.372	J-7049-5

2. Ream valve guide bores, as shown.
3. Remove the sharp corner created by reamer at top of valve guide.



VALVE SEAT REPAIR

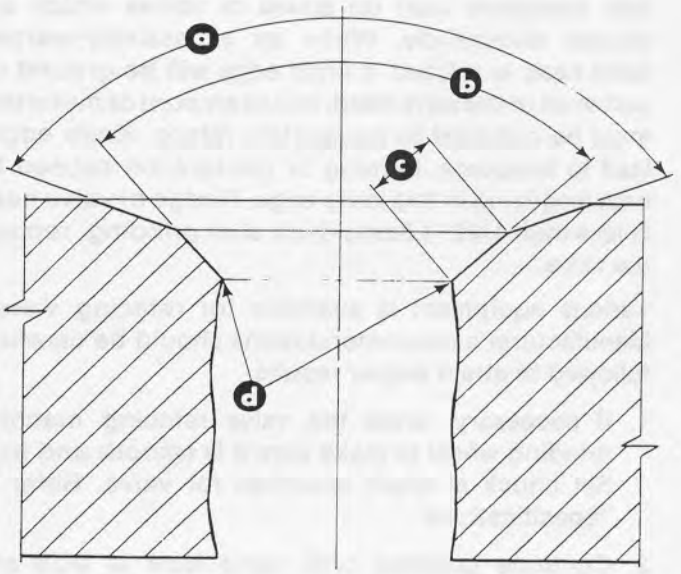
Valve seat reconditioning is very important, since seating of valves must be perfect for engine to deliver maximum power and performance.

Another important factor is valve head cooling. Good contact between each valve and its seat in head is important to insure that heat in valve head will be properly dispersed.

Several different types of equipment are available for reseating valve seats. Equipment manufacturer's recommendations should be followed carefully to attain proper results.

Regardless of type of equipment, however, it is essential that valve guide bores be free from carbon or dirt to insure proper centering of pilot in valve guide.

1. Install expanding pilot in valve guide bore and expand pilot.
2. Place roughing stone or forming stone over pilot and clean up valve seat only. Use a stone that is cut to specifications.
3. Remove roughing stone or forming stone from pilot, place finishing stone (cut to specifications) over pilot and cut just enough metal from seat to provide a smooth finish. Refer to "Specifications".
4. Narrow down valve seats to specified width by grinding with a 30° stone to lower seat and a 60° stone to raise seat.



INTAKE/ EXHAUST

a - Top Edge "Approach Angle" (30°)
b - Seat Angle
c - Seat Width
d - Bottom Edge (60°)

5. Remove expanding pilot and clean cylinder head carefully to remove all chips and grinding from above operations.
6. Measure valve seat width. See "Specifications".
7. Measure valve seat "out-of-round". See "Specifications".

VALVE REPAIR

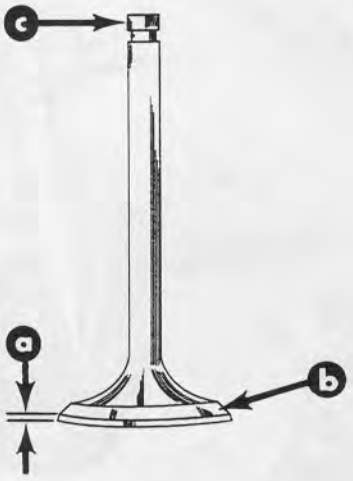
Pitted valves can be refaced to proper angle on a valve grinder, thus insuring correct relation between cylinder head seat and valve mating surface. Replace valves with excessive wear on stems or valves which are warped excessively. When an excessively-warped valve head is refaced, a knife edge will be ground on part or all of the valve head, due to amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition caused by heat localizing in this knife edge. If edge of valve head is less than 1/32" (.8mm) thick after grinding, replace the valve.

Various equipment is available for refacing valves. Manufacturer's recommendations should be carefully followed to attain proper results.

1. If necessary, dress the valve refacing machine grinding wheel to make sure it is smooth and true. Set chuck at angle specified for valve. Refer to "Specifications".
2. Continue grinding until valve face is true and smooth all around the valve. If this makes valve head thin [1/32" (.8mm) minimum], valve must be replaced, or valve will overheat and burn.
3. Remove valve from chuck and place stem in "V" block. Feed valve squarely against grinding wheel to grind any pit from rocker arm end of stem.

IMPORTANT: Only extreme end of valve stem is hardened to resist wear. Do not grind end of stem excessively.

4. After cleaning valve face and cylinder head valve seat of grinding particles, make pencil marks about 1/4" (6mm) across the valve face, place valve in cylinder head and give valve 1/2-turn in each direction while exerting firm pressure on head of valve.
5. Remove valve and check face carefully. If all pencil marks have not been removed at point of contact with valve seat, repeat refacing operation and again recheck for proper seating.



a - 1/32" Minimum
b - Valve Face
c - Stem End

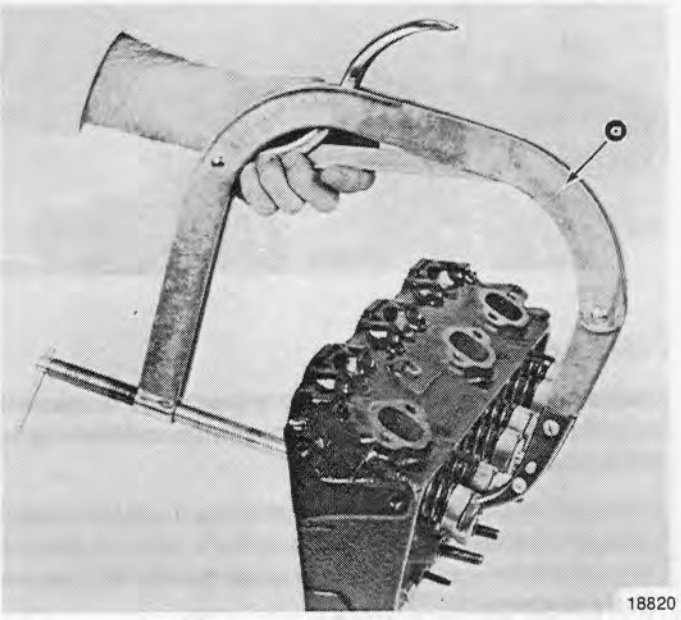
REASSEMBLY

Lubricate valve guides and valve stems with engine oil.

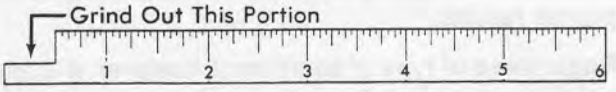
Install each valve in the port from which it was removed or to which it was fitted.

Install valve stem oil seal, valve spring(s) and relate parts on each valve as explained under "Valve Stem Oil Seal and/or Valve Spring".

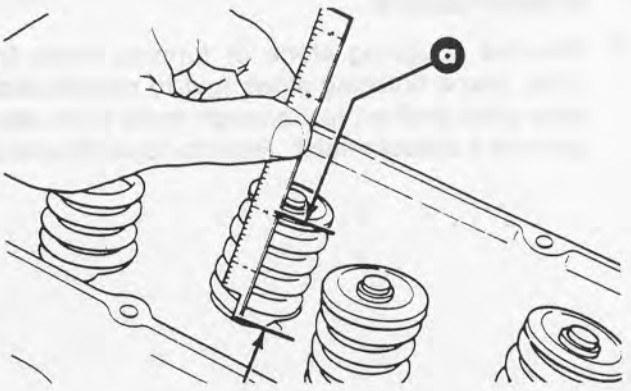
Compress valve spring with Tool J-8062.



Check installed height of the valve springs with a na row, thin scale. A cutaway scale will help.



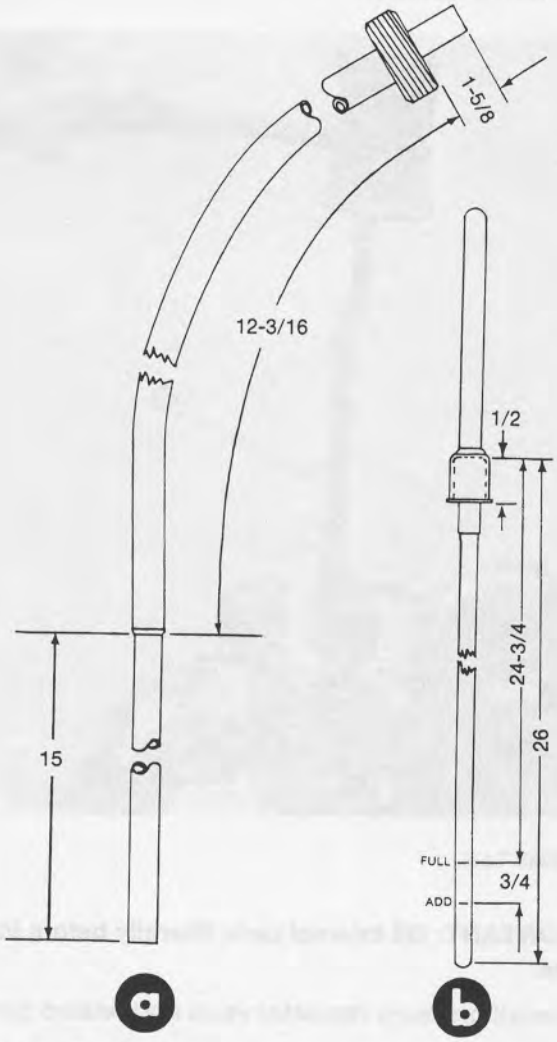
Measure from top of spacer (spring seat) to top of valve spring. If this exceeds specified height, install a valve spring seat shim approximately 1/16" (1.6mm) thick. At no time should spring be shimmed to give an installed height under minimum specified.



Oil Pan

REMOVAL

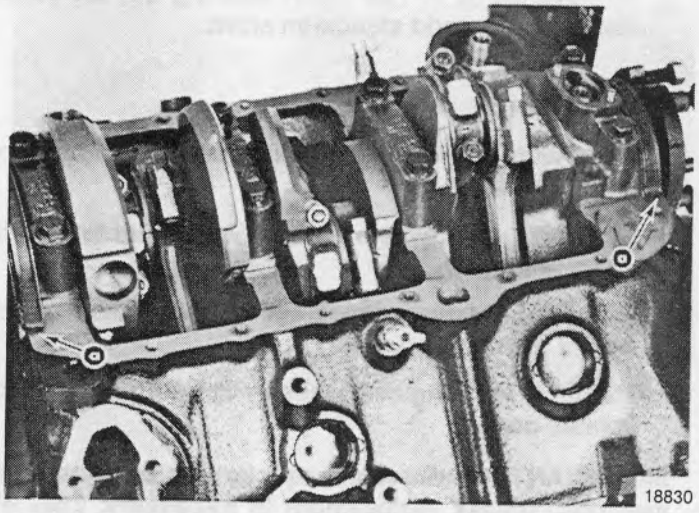
1. Drain coolant.
2. Drain crankcase oil.
3. Remove oil dipstick and tube, if required.
4. Remove oil pan and discard gaskets.



a - Tube
b - Dipstick

INSTALLATION

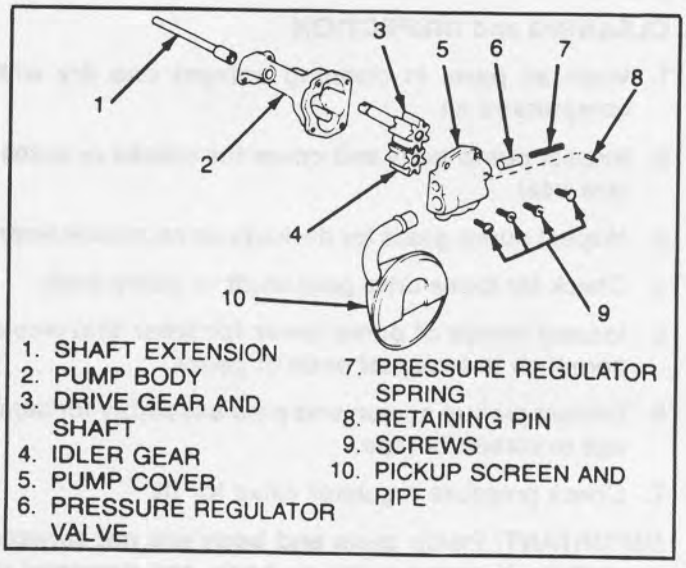
1. Thoroughly clean gasket and seal surfaces on oil pan, cylinder block, rear main bearing cap and crankcase front cover.
2. Coat both sides of oil pan side gaskets with Perfect Seal and place gaskets in position on each side of cylinder block.
3. Apply a 1/8" (3mm) bead of RTV Sealer to front and rear seal mating surfaces on cylinder block rear main bearing cap, front cover and gaskets.



IMPORTANT: RTV Sealer sets up in about 15 minutes. Be sure to complete assembly promptly.

4. Install new front and rear seals, being sure ends of seals are butted properly against side gaskets.

Oil Pump



The oil pump consists of 2 gears and a pressure regulator valve enclosed in a 2-piece housing. Oil pump is driven by distributor shaft which is driven by a helical gear on camshaft.

A baffle is incorporated on pickup screen to eliminate pressure loss and engine oil pump tubes are bent at special angles.

REMOVAL

1. Remove oil pan.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

DISASSEMBLY

1. Remove pump cover attaching screws and pump cover.

IMPORTANT: Mark gear teeth for reassembly with same teeth indexing.

2. Remove idler gear, drive gear and shaft from pump body.
3. Remove retaining pin, pressure regulator valve and related parts.

IMPORTANT: Do not remove pickup screen and pipe assembly, unless replacement is necessary. Loss of press fit condition could result in an air leak and loss of oil pressure.

IMPORTANT: Do not disturb pickup screen on pipe. This is serviced as an assembly.

4. If pickup screen and pipe assembly requires replacement, mount pump in a soft jawed vise and extract pipe from pump.

CLEANING and INSPECTION

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
4. Check for loose drive gear shaft in pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past ends of gears.
6. Inspect pickup screen and pipe assembly for damage to screen or pipe.
7. Check pressure regulator valve for fit.

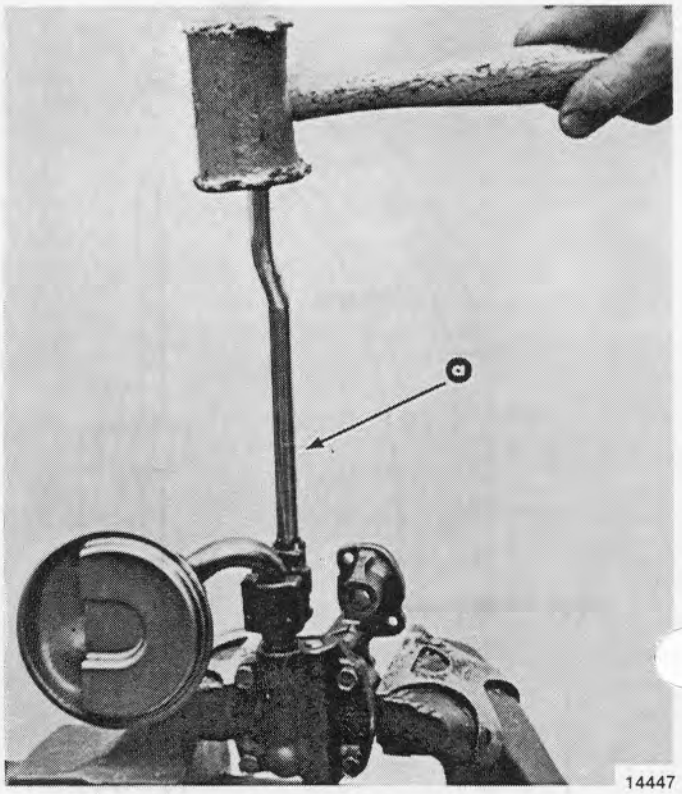
IMPORTANT: Pump gears and body are not serviced separately. If pump gears or body are damaged or worn, replacement of entire oil pump assembly is necessary.

REASSEMBLY

⚠CAUTION

Be careful of twisting, shearing or collapsing pipe while installing in pump. Pickup screen must be parallel to oil pan rails when oil pump is installed.

If pickup screen and pipe assembly was removed, mount pump in a soft-jawed vise, apply Perfect Seal to end of new pipe and using Tool (J-8369), tap the pipe in place with a hammer.



a - J-8369 Tool

IMPORTANT: Oil internal parts liberally before installation.

1. Install pressure regulator valve and related parts.
2. Install drive gear and shaft in pump body.
3. Install idler gear in pump body with smooth side of gear toward pump cover opening. Align marks made in disassembly.
4. Install pump cover and torque attaching screws to 80 lbs. in. (9.0 N.m).
5. Turn drive shaft by hand to check for smooth operation.

INSTALLATION

1. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.
2. Install pump to rear main bearing cap and torque to 65 lbs. ft. (88.1 N.m).

IMPORTANT: Oil pump screen is installed with bottom edge parallel to oil pan rails.

3. Install oil pan as outlined.

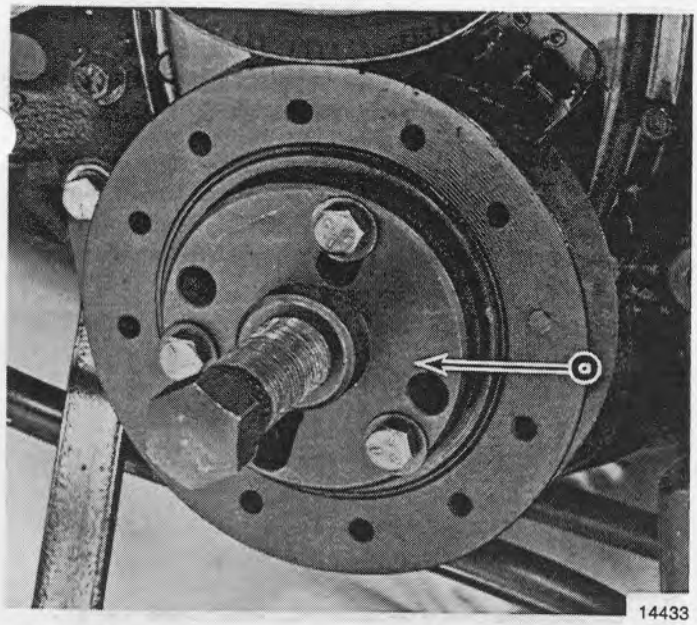
Torsional Damper

REMOVAL

1. Remove drive belts.
2. Remove drive pulley, then remove damper retaining bolt.

IMPORTANT: Do not use a universal claw type puller to remove torsional damper (in next step) as outside ring of damper is bonded in rubber to the hub and use of claw type puller may break the bond.

3. Remove damper with Tool J-23523-03.



14433

a - J-23523-03 Tool

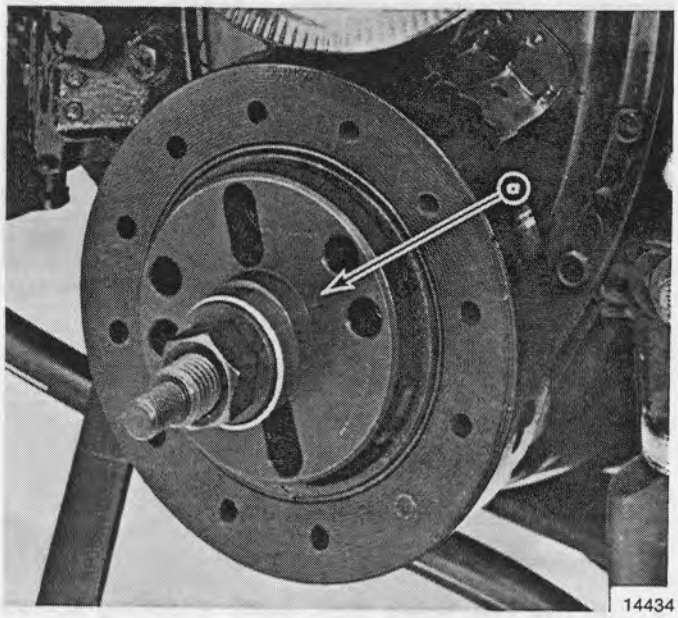
INSTALLATION

IMPORTANT: The inertia weight section of torsional damper is assembled to the hub with a rubber type material. The installation procedure (with proper tool) must be followed or movement of the inertia weight on the hub will destroy the tuning of the torsional damper.

1. Coat front cover seal contact area (on damper) with engine oil.
2. Pull damper onto crankshaft, using Tool J-23523-03, as follows:
   a. Install appropriate end of threaded rod into crankshaft.

IMPORTANT: Be sure to install threaded rod in crankshaft so that at least 1/2" (13mm) of thread engagement is obtained to prevent damage to threads.

   b. Install plate, thrust bearing, washer and nut on rod.
   c. Pull damper onto crankshaft (by turning nut) until it bottoms-out.



14434

a - J-23523-03 Tool

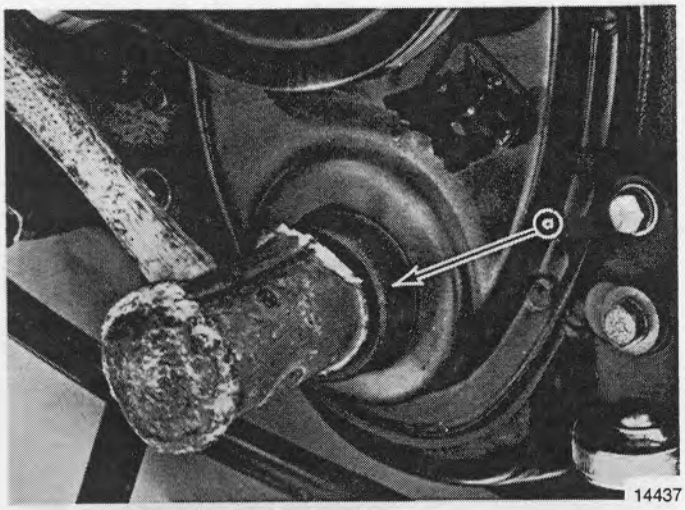
   d. Remove tool from crankshaft, then, install damper retaining bolt and torque to 60 lb. ft. (81 N.m).

3. Install drive pulley(s).
4. Install and adjust drive belts.

Crankcase Front Cover Oil Seal

OIL SEAL REPLACEMENT (Without Removing Front Cover)

1. Remove torsional damper.
2. Pry seal out of cover from the front with a large screwdriver, being careful not to distort front cover or damage crankshaft seal surface.
3. Install new seal with open end of seal inward, using Tool J-23042. Drive seal in until it just bottoms out. Do not use excessive force.
4. Reinstall torsional damper.



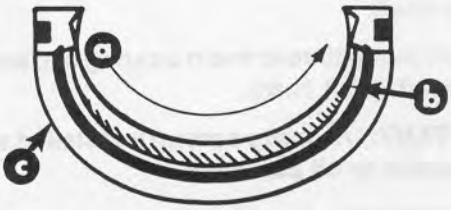
a - J-23042 Tool

REMOVAL

1. Remove engine from boat.
2. Remove torsional damper and oil pan.
3. Remove water circulating pump.
4. Remove crankcase front cover attaching screws and remove cover. Remove and discard cover gasket.
5. If damaged, drive oil seal out of front cover (from the rear) with a punch.

INSTALLATION

IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.

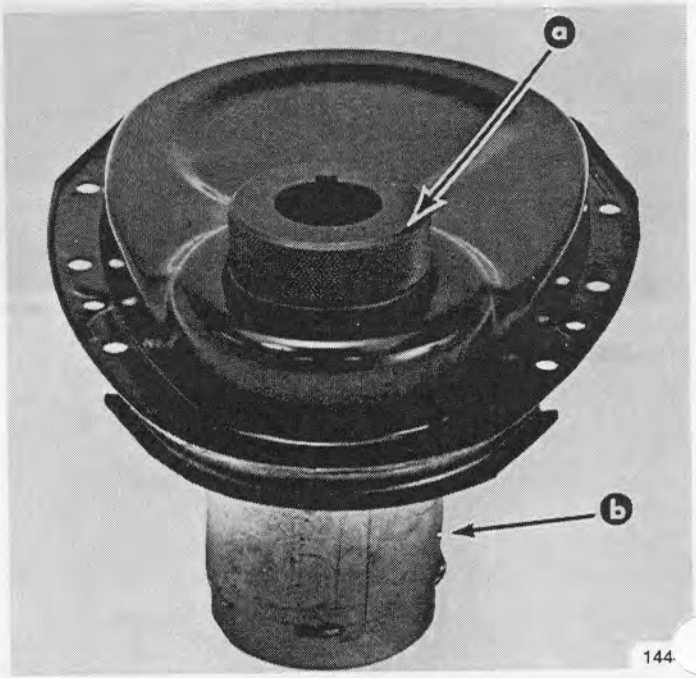


a - Engine Rotation (Viewed-Rear to Front)
b - Lip Toward Inside of Engine
c - Seal with Helical Grooves

a - Can Be Used On Any Rotation Engine
b - Seal Lip Toward Inside of Engine

Front Seal WITHOUT Helical Grooves

1. Clean front cover in solvent and dry with compressed air. Clean old gasket material and sealer from mating surfaces on cover and cylinder block. Check gasket surface on front cover for distortion and true if necessary. Surfaces MUST BE clean and flat or oil leakage may result.
2. Install oil seal in cover with lip of seal toward inside of engine, using Tool J-23042. Support cover around seal area with appropriate tool as shown.



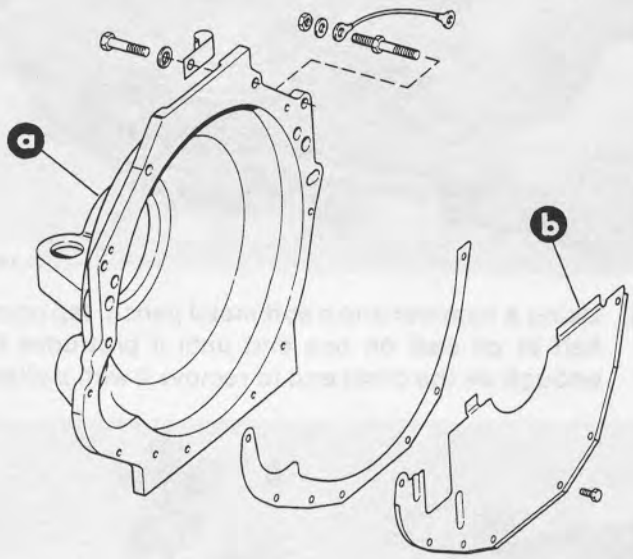
a - J-23042 Tool
b - Support (To Prevent Distorting Cover)

3. Coat both sides of front cover gasket with Perfect Seal and place in position on engine.
4. Install front cover, making sure holes in cover align with dowel pins in block. Torque front cover 80 lbs. in. (9.0 N.m).
5. Install oil pan and torsional damper as outlined.
6. Install water circulating pump. Torque to 30 lbs. ft. (40.1 N.m).
7. Reinstall engine in boat.
8. Fill crankcase with engine oil.
9. Start engine and check for water and oil leaks.

Flywheel

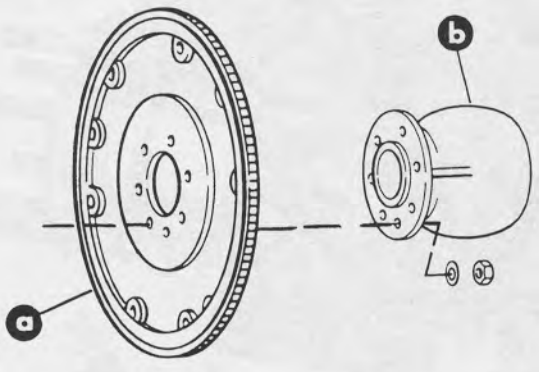
REMOVAL

1. Remove engine from boat.
2. Remove flywheel housing and related parts.



a - Flywheel Housing b - Cover

3. Remove engine coupler and flywheel.



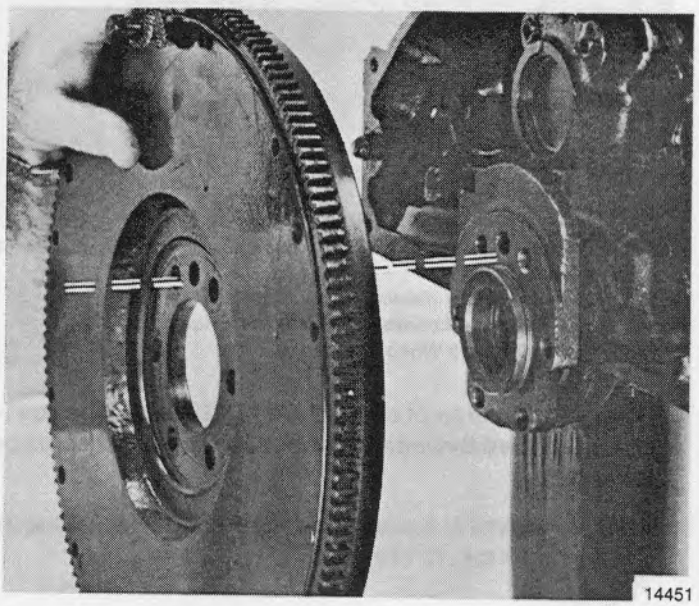
a - Flywheel b - Coupler

INSPECTION

1. Check flywheel ring gear for worn or missing teeth.
2. Inspect coupler for worn splines or torn rubber.

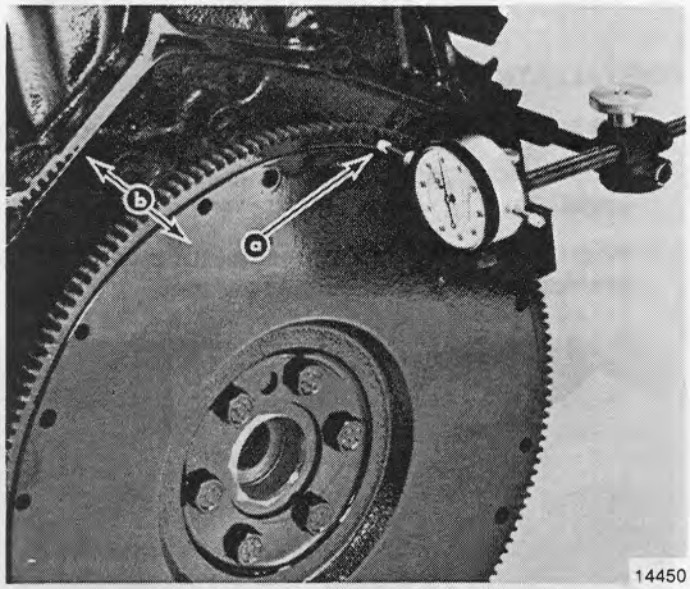
INSTALLATION

1. Clean mating surfaces of flywheel and crankshaft.
2. If removed, apply Loctite-A to threads of studs and install.
3. Align dowel hole in flywheel with dowel hole in crankshaft flange and install flywheel.



4. Install coupler, washers and locknuts. Torque to 40 lbs. ft. (54 N.m).
5. Lubricate coupler splines with 2-4-C Multi-Lube.

6. Check flywheel runout by mounting dial indicator against machined surface of flywheel.



14450

a - .008" (.203mm) Max. Runout
b - Hold Flywheel and Crankshaft Forward or Rearward As Far As It Will Go When Taking Reading

7. Runout should not exceed .008" (.203mm) if excessive, remove flywheel and check for burrs or replace flywheel.
8. Install flywheel housing and related parts. Torque bolts to 30 lbs. ft. (40.7 N.m).

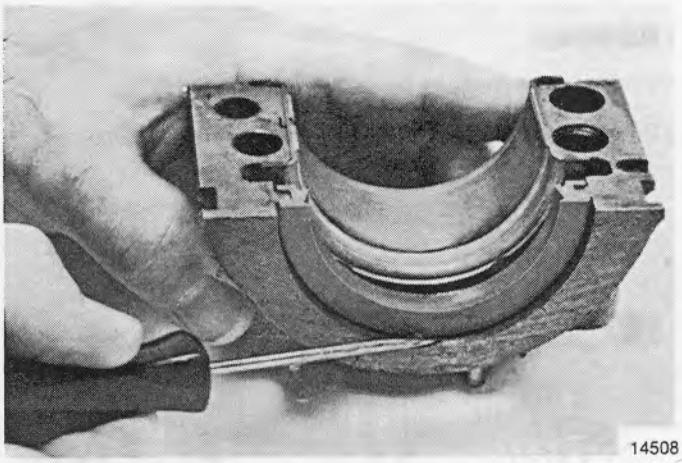
Oil Seal (Rear Main)

REPLACEMENT

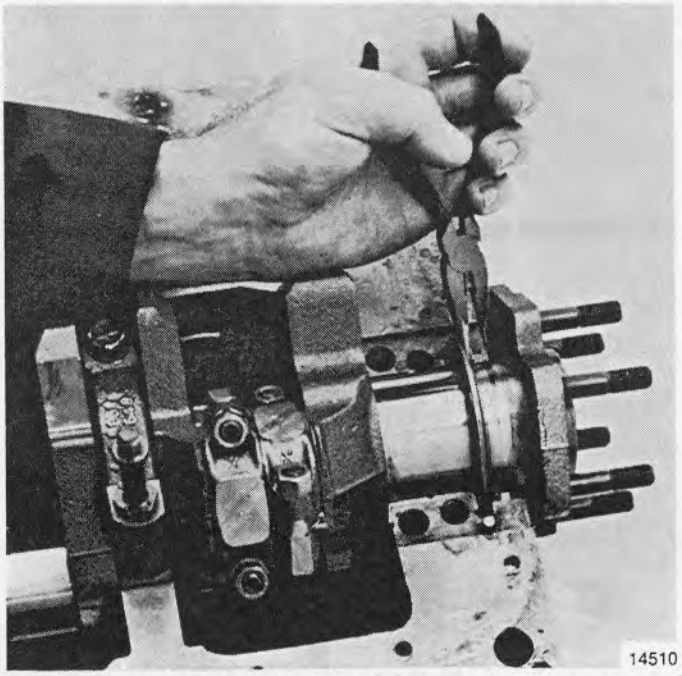
Rear main bearing oil seal can be replaced (both halves) without removing crankshaft.

IMPORTANT: Always replace upper and lower seal as a unit. Install with lip facing toward inside of engine.

1. Remove oil pan and oil pump.
2. Remove rear main bearing cap.
3. Remove lower half of oil seal from the bearing cap by prying from the bottom with a small screwdriver. Be careful not to damage seal seating surface.


14508

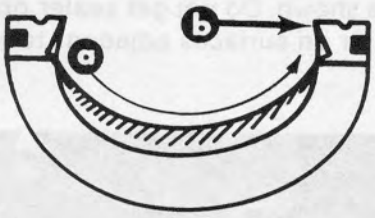
4. Using a hammer and a soft metal punch, tap upper half of oil seal on one end until it protrudes far enough on the other end to remove it with a pliers.


14510

5. Clean, rear main bearing cap, cylinder block and crankshaft with solvent and blow dry with compressed air. Be sure all of the old sealer is removed from bearing cap and cylinder block mating surfaces.

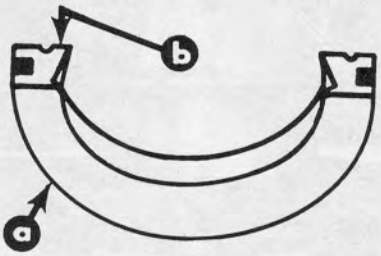
INSTALLATION

IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.



541-H

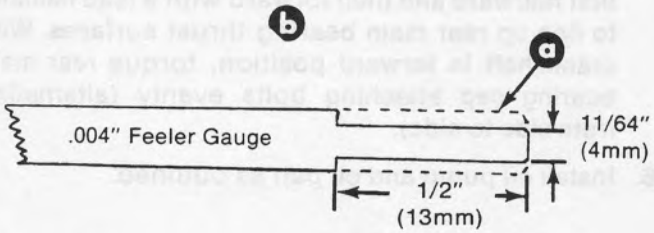
a - Left Hand Rotation (Flywheel End Looking Forward)
b - Seal Lip Toward Inside of Engine



540-H

a - Can Be Used On Any Rotation Engine
b - Seal Lip Toward Inside of Engine

Extreme care must be exercised when installing seal to prevent damage to sealing bead, located in the channel on outside diameter of the seal. To protect this bead, installation tool MUST BE used. Construct tool using .004" (.1mm) shim stock, if tool is not supplied with seal.

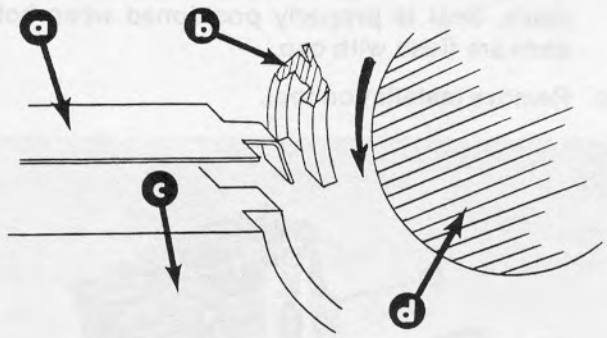


a - Cut Away
b - .004" Feeler Gauge

1. Coat lips and sealing bead on new rear oil seal with engine oil. Keep oil off of seal parting surfaces.

IMPORTANT: Be sure to install oil seal with lip facing toward inside of engine.

2. Install upper half of oil seal:
   a. Position tip of installation tool between crankshaft and seal seating surface in cylinder block.
   b. Position upper half of seal between crankshaft and tip of installation tool so that seal bead contacts tips of tool.
   c. Roll upper half of seal around crankshaft using installation tool as a "shoe-horn" to protect seal bead from sharp corner of seal seating surface.



a - Installation Tool
b - Seal
c - Engine Block
d - Crankshaft

IMPORTANT: Installation tool must remain in position until seal is properly positioned with both ends flush with block.

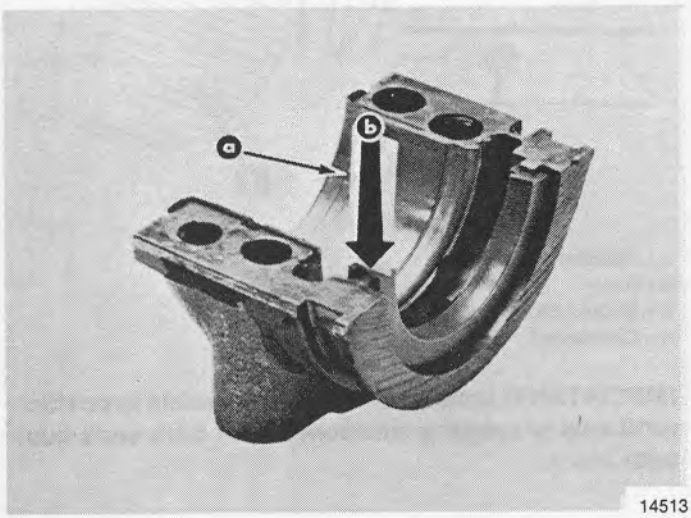
   d. After both ends of seal half are flush with block, remove installation tool.

3. Install lower half of oil seal:

   a. Position oil seal half in rear main bearing cap so that one end is slightly below mating surface and seal lip is facing toward bearing. Do not allow sealing bead on other end of seal half to contact seal seating surface.

   b. Insert installation tool in between sealing bead and seal seating surface, then, using tool as a "shoe-horn" to protect sealing bead from sharp corner of seal seating surface, roll seal into place. Seal is properly positioned when both ends are flush with cap.

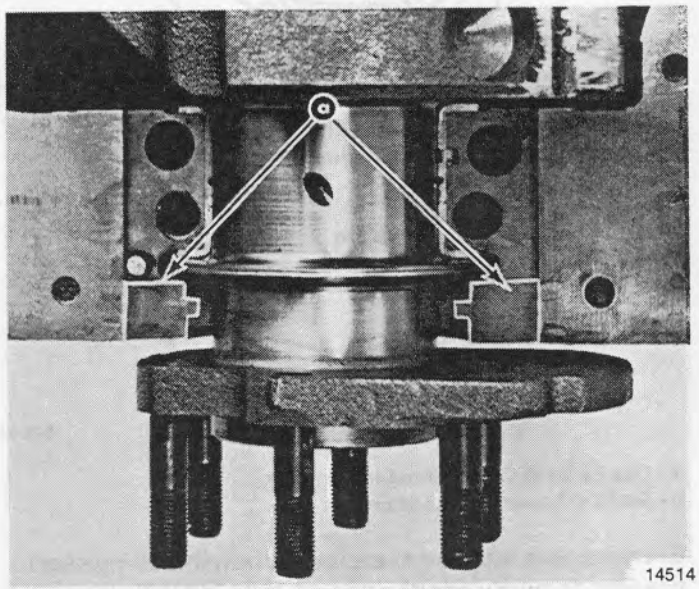
   c. Remove installation tool.



14513

a - Installation Tool
b - Roll Seal Half Into Position in This Direction

4. Make sure that bearing cap and cylinder block mating surfaces and oil seal parting surfaces are clean and free of oil, then apply Perfect Seal to block at locations shown. Do not get sealer on seal parting surfaces or on surfaces adjacent to main bearing inserts.



14514

a - Apply Perfect Seal to Outlined Area Only

5. Install rear main bearing cap and torque attaching bolts to 10-12 ft. lbs. (13-16 N.m). Tap crankshaft first rearward and then forward with a lead hammer to line up rear main bearing thrust surfaces. Wit crankshaft in forward position, torque rear main bearing cap attaching bolts evenly (alternating from side to side).

6. Install oil pump and oil pan as outlined.

Main Bearings

INSPECTION

In general (except No. 1 bearing), lower half of bearing shows a greater wear and most distress from fatigue. After inspection, if lower half is suitable for use, it can be assumed that the upper half also is satisfactory. If lower half is worn or damaged, both upper and lower halves should be replaced. Never replace one half without replacing the other.

CHECKING CLEARANCE

To obtain best results, use Plastigage (or its equivalent), a wax-like plastic material which will compress evenly between bearing and journal surfaces without damaging either surface. With engine upside-down, crankshaft will rest on upper bearings, and total clearance can be measured between lower bearing and journal.

IMPORTANT: To assure proper seating of crankshaft, all bearing cap bolts should be at their specified torque. In addition, surface of crankshaft journal and bearing should be wiped clean of oil before checking fit of bearings. Remove oil seal from rear main bearing cap prior to checking clearance.

1. With oil pan, and oil pump removed (starting with rear main bearing), remove bearing cap and wipe oil from journal and bearing cap.

   Main bearings are precision insert type and do not utilize shims for adjustment. If clearances are excessive, a new bearing (both upper and lower halves) will be required. Bearings are available in standard size and undersize. Selective fitting of both rod and main bearing inserts is necessary in production to obtain close tolerances. Consequently, one half of a standard insert may have one half of a .001" undersize insert which will decrease clearance .0005" from using a full standard bearing.

   When a production crankshaft cannot be precision fitted by this method, it then is ground .009" (.229mm) undersize on main journals only. A .009" undersize bearing and .010" undersize bearing may be used for precision fitting in the same manner as previously described. Any engine fitted with a .009" undersize crankshaft will be identified by the following markings:

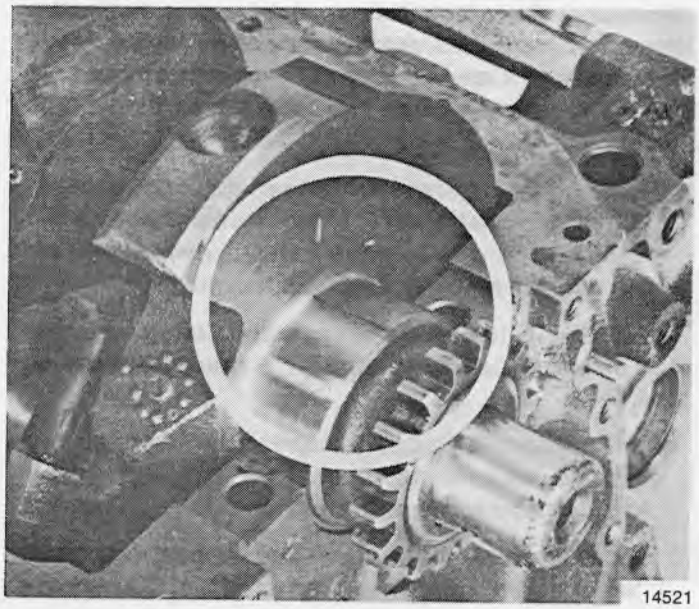
   ".009" will be stamped on crankshaft counterweight forward of center main journal.

   A figure "9" will be stamped on block at left front oil pan rail.

   A crankshaft with an undersize journal will be painted with light green on each side of the affected journal.

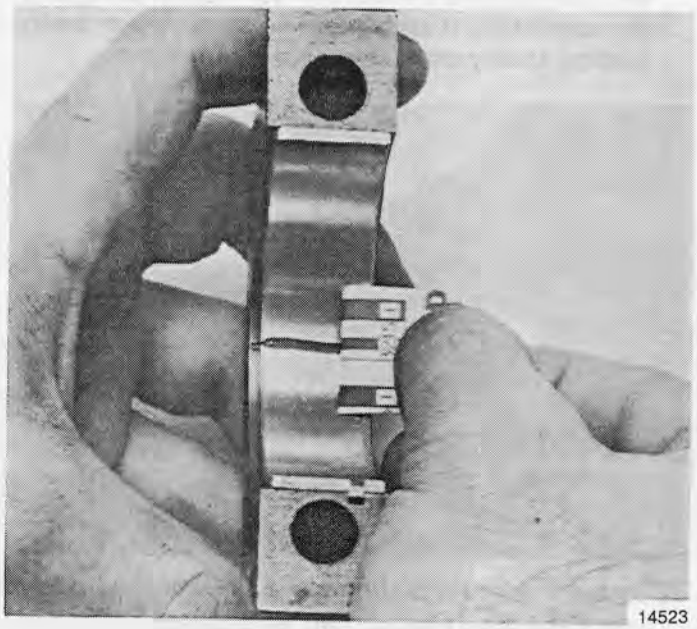
IMPORTANT: If crankshaft has an undersize journal and a new bearing is required, journal MUST BE reconditioned to accept a .010" or a .020" undersize bearing as .009" undersize bearings are not available for service.

2. Place a piece of gauging plastic full width of bearing (parallel to crankshaft) on journal.


14521

IMPORTANT: Do not rotate crankshaft while gauging plastic is between bearing and journal.

3. Install bearing cap and torque retaining bolts evenly to specifications.
4. Remove bearing cap. Flattened gauging plastic will be found adhering to either bearing shell or journal.
5. Use graduated scale (correlated in thousandths of an inch) on edge of gauging plastic envelope. Without removing gauging plastic, measure its compressed width (at widest point) with graduations on gauging plastic envelope.

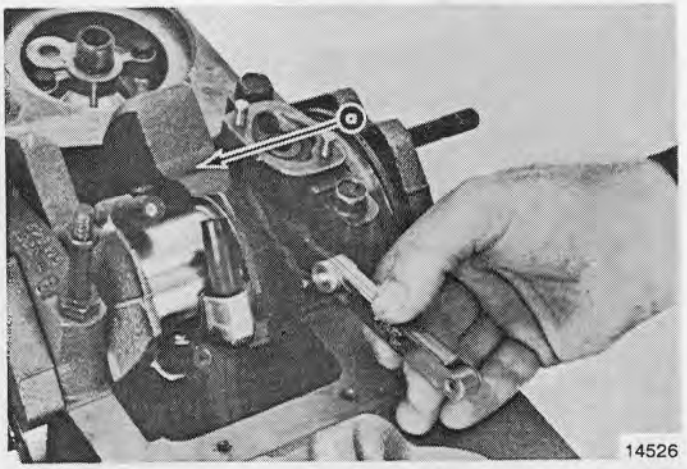

14523

IMPORTANT: Main bearing journals usually wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal [.001" (0.25mm) maximum], be sure to fit to maximum diameter of journal. If bearing is fitted to minimum diameter, and journal is out-of-round .001", interference between bearing and journal will result in rapid bearing failure. If flattened gauging plastic tapers toward middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of bearing or journal. Be sure to measure journal with a micrometer if flattened gauging plastic indicates more than .001" difference.

6. If bearing clearance is within specifications, bearing insert is satisfactory. If clearance is not within specifications, replace the insert. Always replace both upper and lower insert as a unit.

IMPORTANT: If a new bearing cap is being installed and clearance is less than .001", inspect for burrs or nicks.

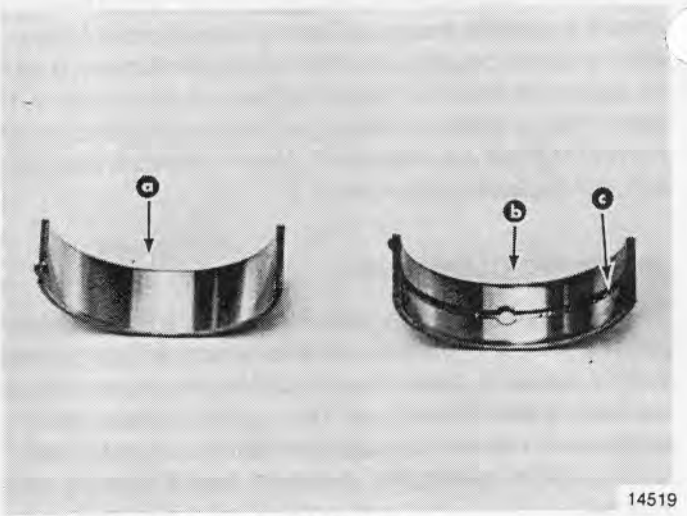
7. A standard .001" or .002" undersize bearing may produce proper clearance. If not, regrind crankshaft journal for use with next undersize bearing.
8. Proceed to next bearing. After all bearings have been checked, rotate crankshaft to see that excessive drag does not exist.
9. Install front 3 main bearing caps and torque evenly to 70 lbs. ft. (95.0 N.m).
10. Install rear main bearing cap and torque attaching bolts to 10-12 ft. lbs. (13-16 N.m). Tap end of crankshaft first rearward and then forward with a hammer to align rear main bearing thrust surfaces. With crankshaft in forward position, torque rear main bearing attaching bolts EVENLY (alternating from side to side) to 70 lbs. ft. (95.0 N.m).
11. Measure crankshaft end play with a feeler gauge by forcing crankshaft forward and measuring clearance between the front of the rear main bearing and the crankshaft. If clearance is excessive rear main bearing and/or crankshaft must be replaced.



12. Install a new rear main bearing oil seal in cylinder block and main bearing cap, as outlined.

REPLACEMENT

IMPORTANT: Main bearings may be replaced with or without removing crankshaft.



a - Lower Bearing Insert (Install in Cap)
b - Upper Bearing Insert (Install in Block)
c - Oil Groove

With Crankshaft Removed:

1. Remove and inspect crankshaft.
2. Remove main bearings from cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in cylinder block and main bearing caps.
4. Install crankshaft.

Without Crankshaft Removed:

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Replace main bearing upper half as follows:
   a. Install main bearing removing and installing tool J-8080 in crankshaft journal oil hole.

IMPORTANT: If tool is not available, bend a cotter pin.

   b. Rotate crankshaft clockwise (as viewed from front of engine). This will roll upper bearing out of block.
   c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and notched side of block. Rotate bearing into place and remove tool from oil hole in crankshaft journal.
3. Oil new lower bearing and install in bearing cap.
4. Install main bearing cap with arrows pointing toward front of engine.
5. Torque main bearing cap bolts to 70 lbs. ft. (95.0 N.m).

Connecting Rod Bearings

Connecting rod bearings are precision insert type and do not utilize shims for adjustment. Do not file rods or rod caps. If clearances are found to be excessive, a new bearing will be required. Bearings are available in standard size and undersize for new and used standard size crankshafts and reconditioned crankshafts.

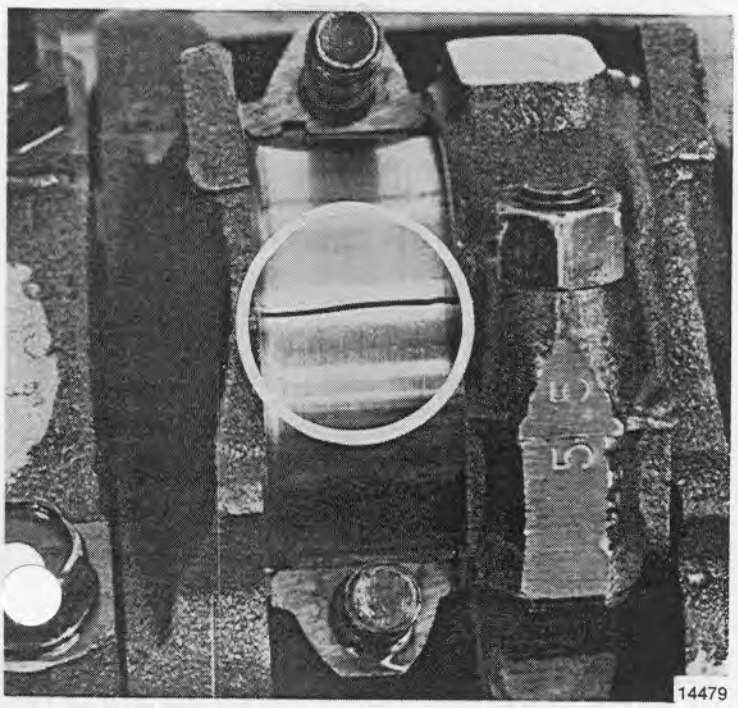
INSPECTION and REPLACEMENT

1. With oil pan and oil pump removed, remove connecting rod cap and bearing.
2. Inspect bearing for wear or damage and replace unsatisfactory bearings.
3. Wipe bearings and crankpin clean of oil.
4. Measure crankpin for out-of-round or taper with a micrometer. If not within specifications, replace or recondition crankshaft. If within specifications, and a new bearing is to be installed, measure maximum diameter of crankpin to determine new bearing size required.
5. Measure new or used bearing clearances with Plastigage or its equivalent.

IMPORTANT: If a bearing is being fitted to an out-of-round crankpin, be sure to fit to maximum diameter of crankpin. If bearing is fitted to minimum diameter, and crankpin is out-of-round .001" (.025mm) or more, interference between bearing and crankpin will result in rapid bearing failure.

a. Install bearing in connecting rod and cap.

b. Place a piece of gauging plastic the full width of crankpin (parallel to crankshaft).



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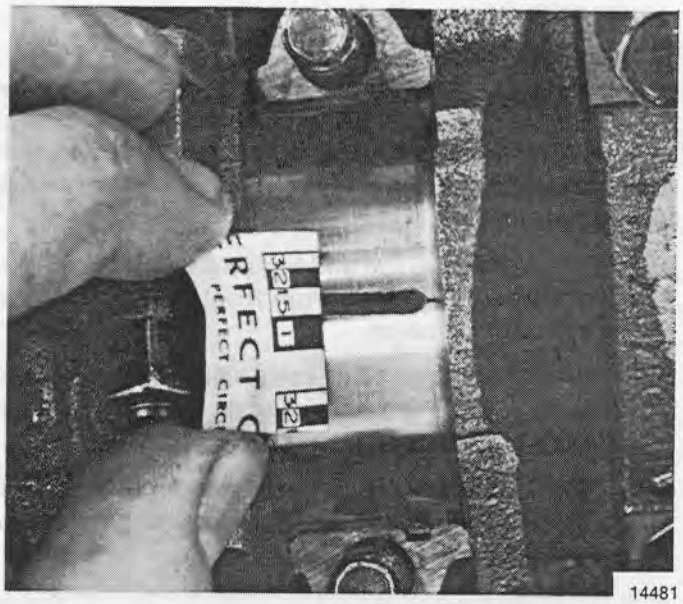
c. Install bearing cap and torque nuts evenly to 45 lbs. ft. (61.0 N.m).

IMPORTANT: Do not turn crankshaft with gauging plastic installed.

d. Remove bearing cap and, using scale on gauging plastic envelope, measure gauging plastic width at the widest point.



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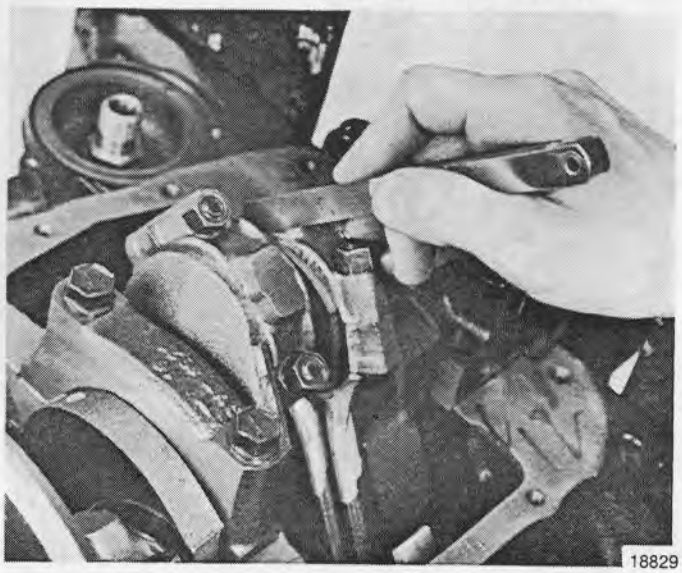
6. If clearance exceeds specifications, select a new, correct size bearing and recheck clearance.
7. Coat bearing surface with oil, install rod cap and torque nuts to 45 lbs. ft. (61.0 N.m).
8. When all connecting rod bearings have been installed, tap each rod lightly (parallel to crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (see specifications) between connecting rod caps.



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Connecting Rod/Piston Assembly

REMOVAL

1. With oil pan, oil pump and cylinder head removed, use a ridge reamer to remove any ridge and/or deposits from upper end of cylinder bore.

IMPORTANT: Before ridge and/or deposits are removed, turn crankshaft until piston is at bottom of stroke and place a cloth on top of piston to collect cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke, then remove cloth and cuttings.

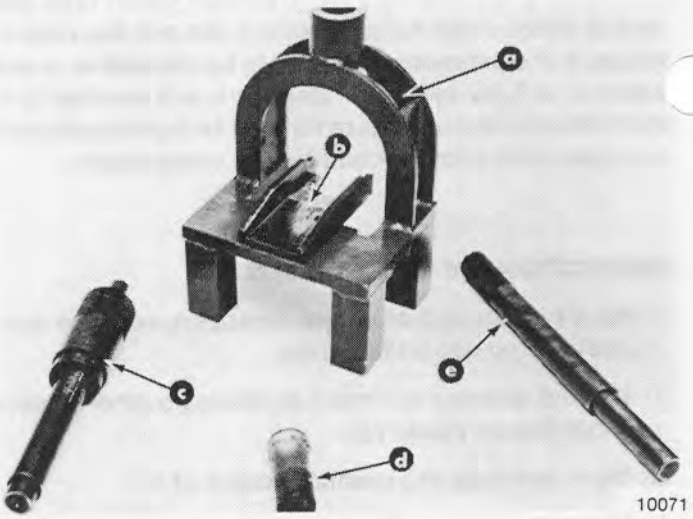
2. Mark connecting rod and bearing caps left bank 1, 3, 5, right bank 2, 4, 6, from front to rear on same side as piston thrust.
3. Remove connecting rod cap and install tool J-5239 (3/8") on bolts. Push connecting rod and piston assembly out of top of cylinder block.

IMPORTANT: It will be necessary to turn crankshaft slightly to disconnect and remove some connecting rod and piston assemblies.

a - J-5239 Tool

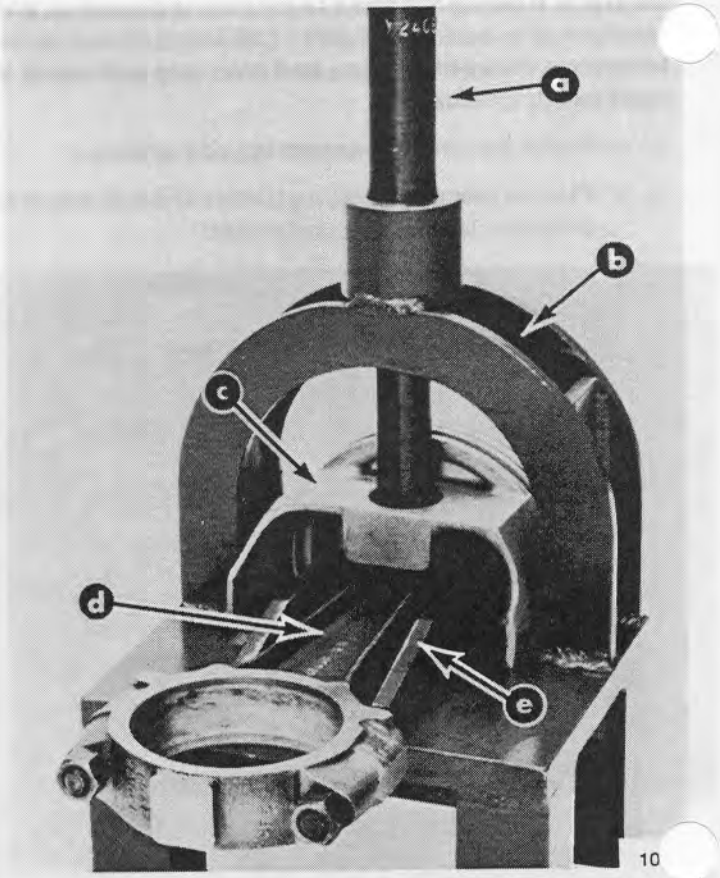
DISASSEMBLY

1. Use Tool Kit J-24086-100.



a - Arched Base
b - Rod Support
c - Adjustable Installer
d - Piston Pin Guide
e - Piston Pin Remover

2. Position connecting rod onto tool rod support with rod support inserted between connecting rod end and piston. Align piston pin with hole located in top of arched base.
3. Insert pin remover thru hole (located in top of arched base) and into piston pin hole. Press on pin remover to remove piston pin.



a - Piston Pin Remover
b - Arched Base
c - Piston
d - Connecting Rod
e - Rod Support

CLEANING and INSPECTION

Connecting Rods:

1. Wash connecting rods in cleaning solvent and dry with compressed air.
2. Check for twisted or bent rods and inspect for nicks or cracks. Replace damaged connecting rods.

Pistons:

1. Clean varnish from piston skirts and pins with a cleaning solvent. Do not wire brush any part of piston. Clean ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.
2. Inspect piston for cracked ring lands, skirts or pin bosses, wavy worn ring lands, scuffed or damaged skirts or eroded areas at top of piston. Replace pistons which are damaged or show signs of excessive wear.
3. Inspect grooves for nicks or burrs that might cause rings to hang up.
4. Measure piston skirt and check clearance as outlined under "Piston Selection - Cylinder Block".

Piston Pins:

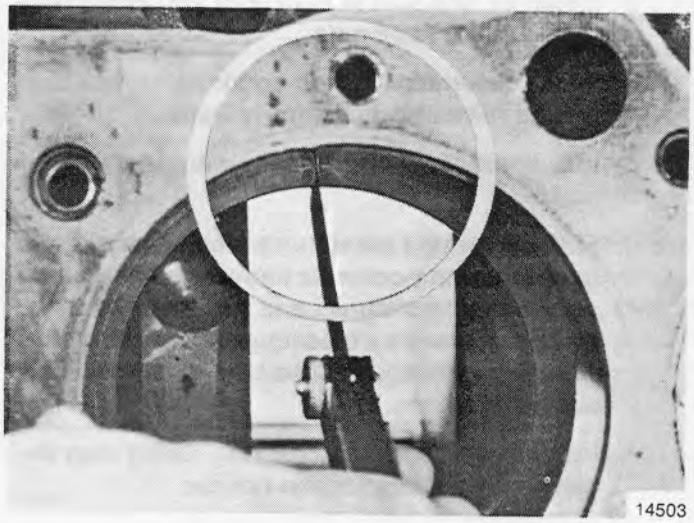
1. Piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, piston and piston pin are a matched set and not serviced separately.
2. Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when measured. Measure piston pin with a micrometer and piston pin bore with a dial bore gauge or inside micrometer. If clearance is in excess of the .001" (.025mm) wear limit, replace piston and piston pin assembly.

Piston Rings:

All compression rings are marked on upper side of ring. When installing compression rings, make sure that marked side is toward top of piston.

Oil control rings are a 3-piece type, consisting of 2 segments (rails) and a spacer.

1. Select rings comparable in size to piston being used.
2. Slip compression ring in cylinder bore, then press ring down into cylinder bore about 1/4" (6mm) (below ring travel). Be sure that ring is square with cylinder wall.
3. Measure gap between ends of ring with a feeler gauge.



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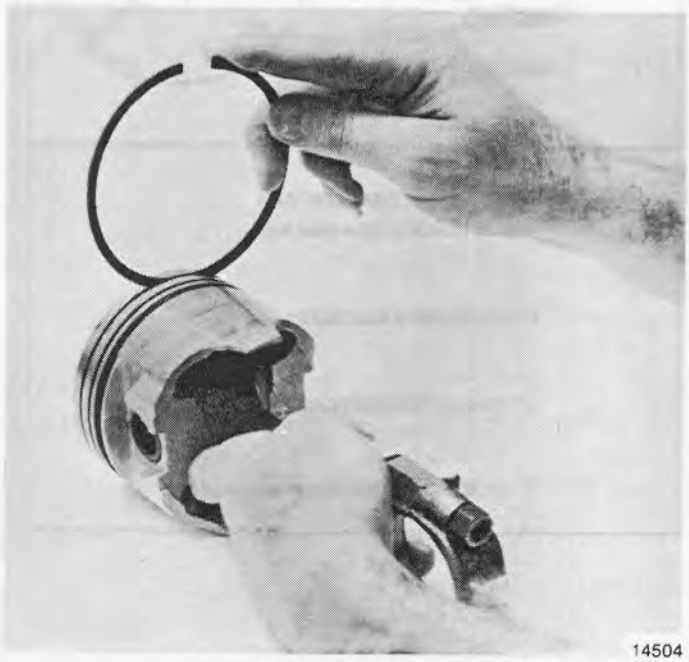
4. If gap between ends of ring is below specifications, remove ring and try another for fit.
5. Fit each compression ring to cylinder in which it is going to be used.
6. Clean and inspect pistons, if not previously done.
7. Slip outer surface of top and second compression ring into respective piston ring groove and roll ring entirely around the groove to make sure that ring is free. If binding occurs at any point, determine cause. If caused by ring groove, remove by dressing with a fine cut file. If binding is caused by a distorted ring, check a new ring.



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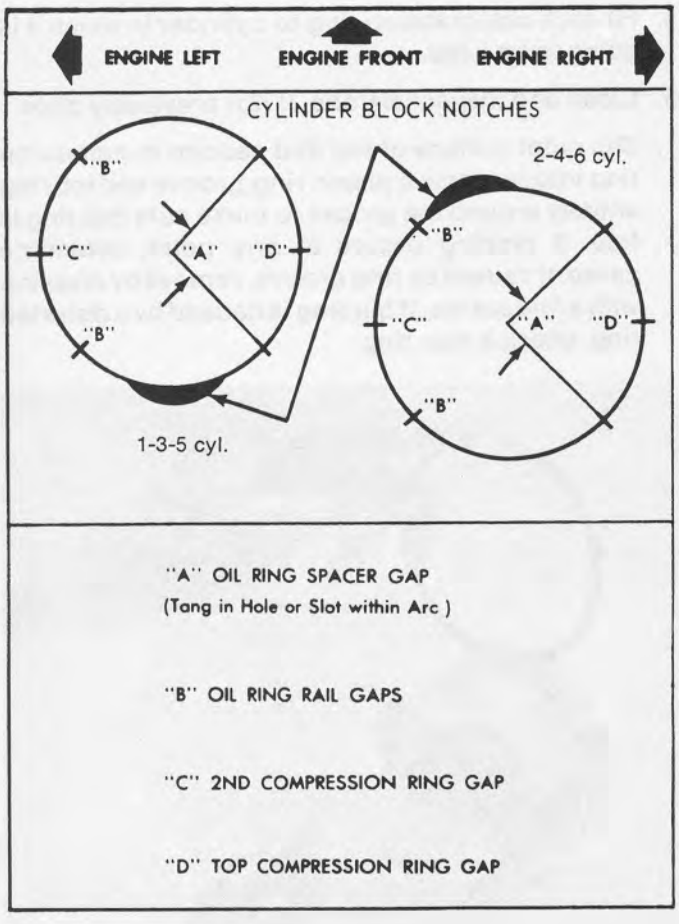
8. Install piston ring as shown. Use 91-24697 piston ring expanders for compression ring installation.
   a. Install oil ring spacer in groove and insert anti-rotation tang in oil hole.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point, the cause should be determined and, if caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.
   e. Install lower compression ring, using ring expander, and check location of gap.
   f. Install top compression ring with gap properly located.



9. Proper clearance of piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, clearances between ring and groove surfaces should be measured. See "Specifications".

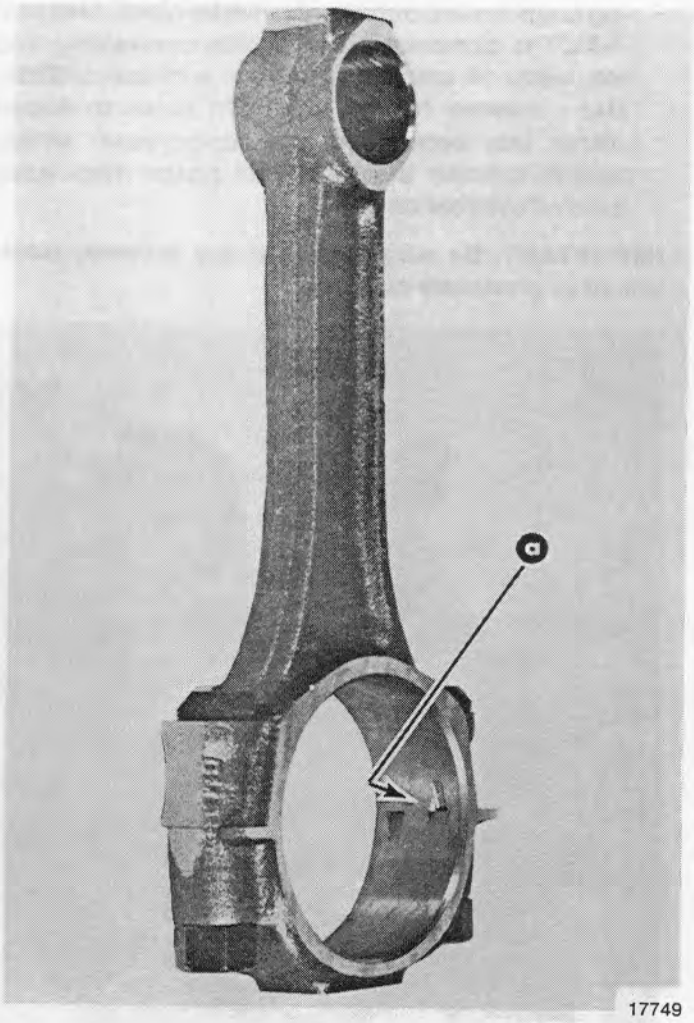
REASSEMBLY

IMPORTANT: When reassembling pistons and connecting rods, the following must be kept in mind:

A - Piston and pin are machine fitted to each other and must remain together as a matched set. Do not intermix pistons and pins.

B - If original pistons and/or connecting rods are being used, be sure to assemble pistons and connecting rods so they can be reinstalled in same cylinder from which they were removed.

1. **Connecting rod bearing tangs are always toward outside of cylinder block.**



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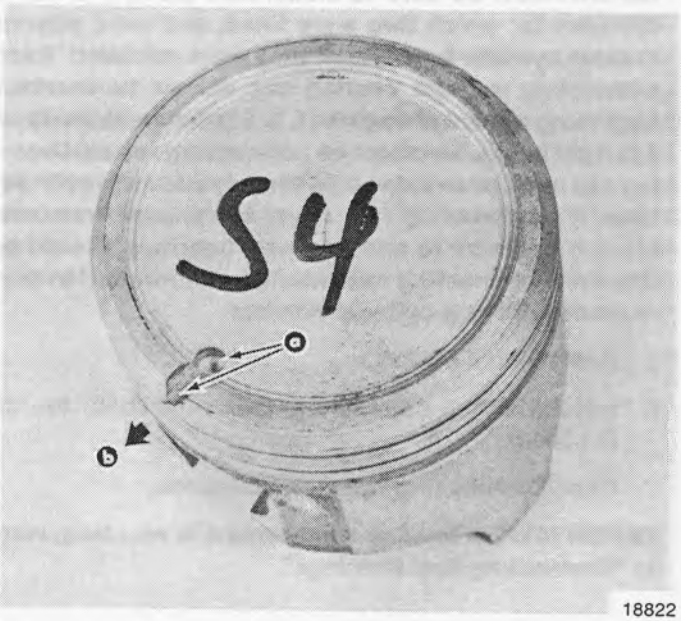
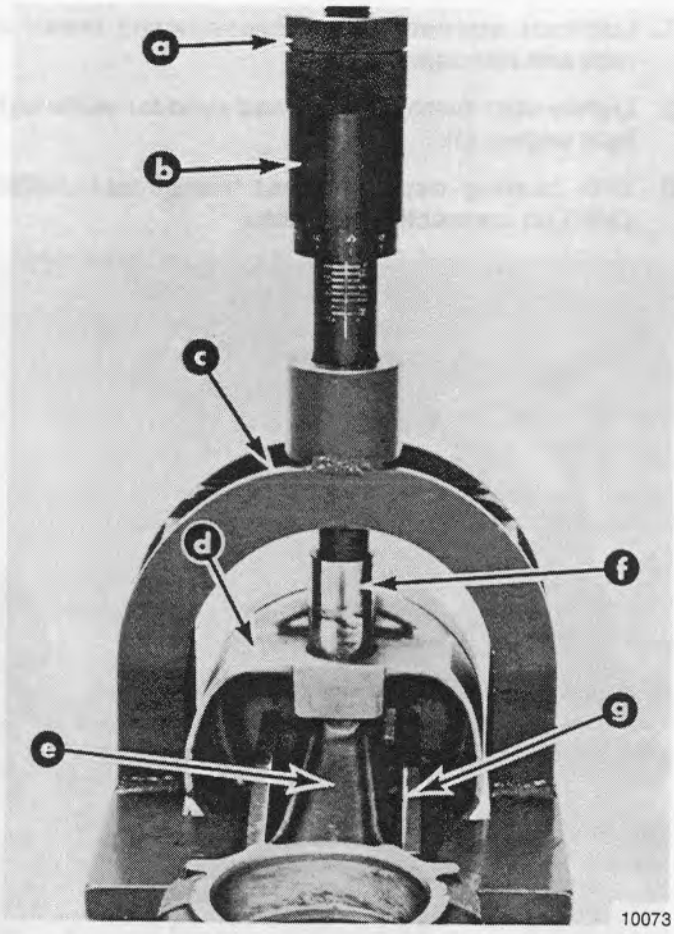
2. **Reference mark on piston, must be positioned correctly for engine that is being repaired.**



18822

a - Notch/Hole
b - Notch Toward Front of Engine

1. Install piston pin with Tool Kit J-24086-100. Refer to chart (furnished with Tool) and select proper size piston pin guide for specific engine being worked on.
2. Lubricate piston pin, piston pin hole in piston and hole in rod end with a light coat of engine oil.
3. Position rod onto rod support and piston onto rod end. Insert piston pin guide thru bottom piston pin hole and into connecting rod. Place piston pin thru top side of piston.
4. Adjust adjustable installer to setting specified on chart (which came with tool) for particular piston installation. Lock adjustable installer with jam nut.
5. Insert adjustable installer thru hole (located on top of arched base) and into piston pin hole. Carefully press on adjustable installer until installer bottoms-out on arched base to install piston pin.



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a - Jam Nut
b - Adjustable Installer
c - Arched Base
d - Piston
e - Connecting Rod
f - Piston Pin
g - Rod Support

6. Check piston for freedom of movement in piston pin bores by moving connecting rod back-and-forth and up-and-down. Connecting rod should move freely (with no resistance) in both directions. If it does not, piston pin is tight in piston pin bores and piston and pin assembly must be replaced.
7. If a new connecting rod has been installed, mark connecting rod and cap (on side of rod and cap with slots for connecting rod bearing tangs) with cylinder number in which it will be installed.

INSTALLATION

IMPORTANT: Cylinder bores must be clean before piston installation. Clean with a light honing, as necessary. Then clean with hot water and detergent wash. After cleaning, swab bores several times with light engine oil and a clean cloth, then wipe with a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.
2. Lightly coat pistons, rings and cylinder walls with light engine oil.
3. With bearing caps removed, install tool J-5239 (3/8") on connecting rod bolts.

a - J-5239 Tool

4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tangs toward outside of cylinder block. Use tool J-8307 to compress rings. Guide connecting rod into place on crankshaft journal with tool J-5239. Use a hammer handle with light blows to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

IMPORTANT: Be sure ring gaps are properly positioned as previously outlined.

IMPORTANT: Be sure to install new pistons in same cylinders for which they were fitted, and used pistons in same cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at front of engine (1, 3, 5 in left bank and 2, 4, 6 in right bank). Numbers on connecting rod and bearing cap must be on same side when installed in cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and connecting rod should be numbered to correspond with new cylinder number.

5. Remove tool J-5239.
6. Install bearing caps and torque nuts to 45 lbs. ft. (61.0 N.m).
7. Check connecting rod side clearance.

IMPORTANT: If bearing replacement is required, refer to "Connecting Rod Bearings".

8. Install the following items:
   a. Oil Pump
   b. Oil Pan
   c. Cylinder Head
9. Install engine in boat.
10. Fill crankcase with oil.
11. Start engine, adjust timing and check for leaks.

Crankshaft

IMPORTANT: If crankshaft is to be replaced, but old pilot bushing is to be reused, bushing can be removed without damage by filling pilot bushing cavity with grease, then, inserting an old transmission input shaft in bore of bushing and hitting it with a hammer. This will create hydraulic pressure in pilot bushing cavity which should force bushing out.

REMOVAL

1. Remove engine from boat.
2. Drain coolant and crankcase oil. Disconnect all hoses.
3. Remove starter motor, flywheel housing and flywheel. Place engine in repair stand.
4. Remove belts, crankshaft pulley and water pump.
5. Remove torsional damper and crankcase front cover.
6. Remove spark plugs.
7. Remove camshaft sprocket and timing chain.
8. Remove oil pan and oil pump.
9. Make sure all bearing caps (main and connecting rods) are marked so they can be installed in their original locations.
10. Remove connecting rod bearing caps, then push piston and rod assemblies toward heads.
11. Remove main bearing caps and carefully lift crankshaft out of cylinder block. Remove rear main bearing oil seal from cylinder block and rear main bearing cap.
12. If new main and/or connecting rod bearings are to be installed, remove main bearing inserts from cylinder block and bearing caps, and/or connecting rod bearing inserts from connecting rod and caps. Install new bearings following procedures outlined. (See "Index".)

CLEANING and INSPECTION

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure main bearing journals and crankpin dimensions with a micrometer for out-of-round, taper or undersize (see "Specifications").
3. Check crankshaft for runout (by supporting at front and rear main bearings journals in "V" blocks) and check at front and rear intermediate journals with a dial indicator (see "Specifications").
4. Replace or recondition crankshaft if not meeting specifications.

INSTALLATION

1. If a new crankshaft is being installed, proceed as follows:
   a. Remove timing sprocket or gear from old crankshaft and reinstall on new crankshaft.
   b. Remove flywheel attaching studs from old crankshaft, using heat if necessary. Reinstall studs in new crankshaft with Loctite-A applied to threads.

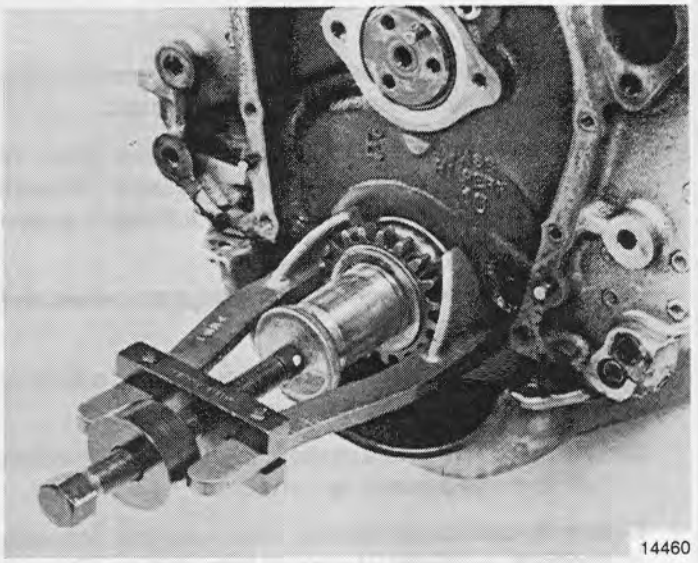
IMPORTANT: Be sure that all bearings and crankshaft journals are clean.

2. Install a new rear main bearing oil seal in cylinder block and rear main bearing cap.
3. Carefully lower crankshaft into place. Be careful not to damage bearing surface.
4. Check clearance of each main bearing, following procedure outlined under "Main Bearing"; see "Index". If bearing clearances are satisfactory, apply a light coat of engine oil to journals and bearings.
5. Install all bearing caps and bolts. Torque all main bearing cap bolts to 70 lbs. ft. (95.0 N.m) When tightening rear main bearing cap. Follow procedure outlined under "Main Bearing"; see "Index".
6. Check clearance for each connecting rod bearing, following procedure under "Connecting Rod Bearings"; see "Index". If bearing clearances are satisfactory, apply a light coat of engine oil to journals and bearings.
7. Install all rod caps and torque nuts to 45 lbs. ft. (61 N.m).
8. Check crankshaft end play. Follow procedure outlined under "Main Bearing"; see "Index".
9. Install oil pump and pan as outlined.
10. Install camshaft sprocket and timing chain.
11. Install crankcase front cover and torsional damper.
12. Remove engine from repair stand and install water pump, flywheel, flywheel housing and starter motor.
13. Install crankshaft pulley and belts.
14. Install spark plugs.
15. Install engine in boat, fill crankcase and install hoses.

Crankshaft Sprocket

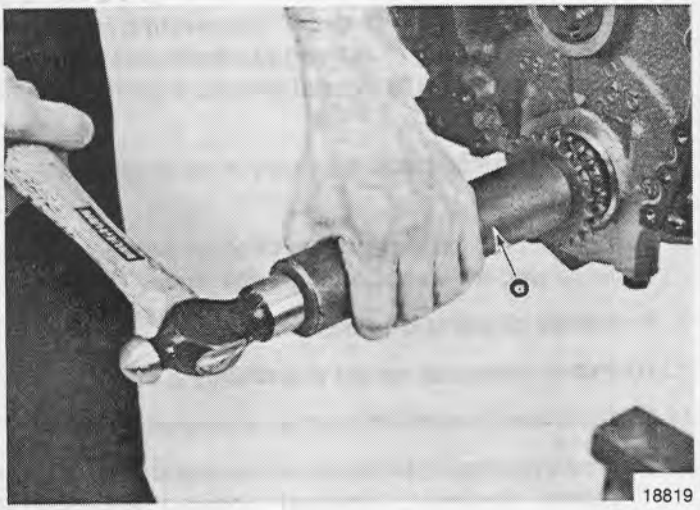
REMOVAL

1. Remove torsional damper and crankcase front cover as outlined.
2. Remove camshaft timing chain as outlined.
3. Using Tool J-5825 remove sprocket.



INSTALLATION

1. Using Tool J-5590 as shown, install sprocket or gear.
2. Install camshaft timing chain as outlined.
3. Install crankcase front cover and torsional damper as outlined.

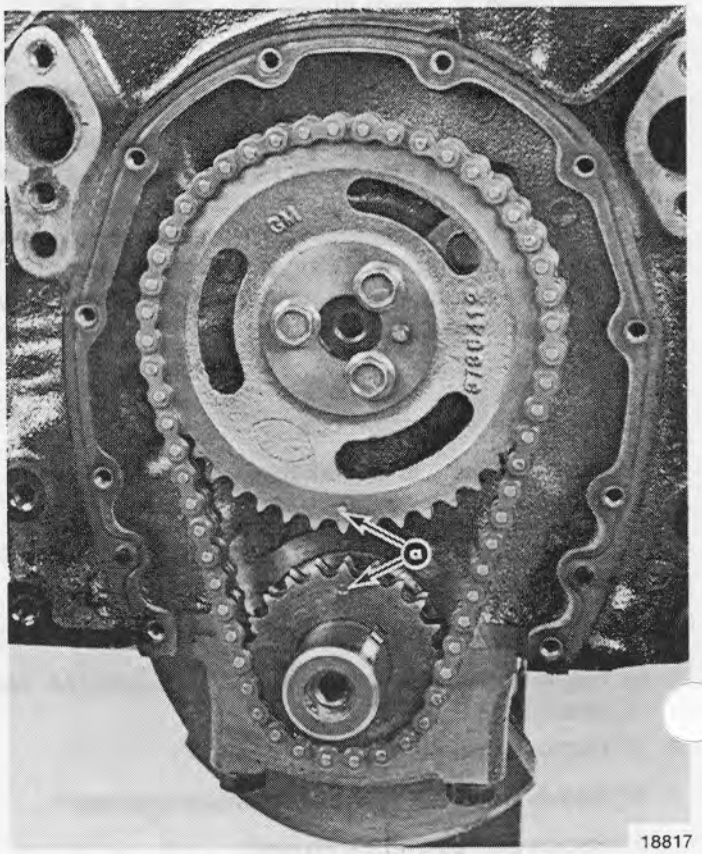


a - Tool J-5590

Timing Chain/Sprockets

REMOVAL

1. Remove torsional damper and crankcase front cover as outlined.
2. Crank engine until marks on camshaft and crankshaft sprockets are in alignment.



a - Alignment Marks

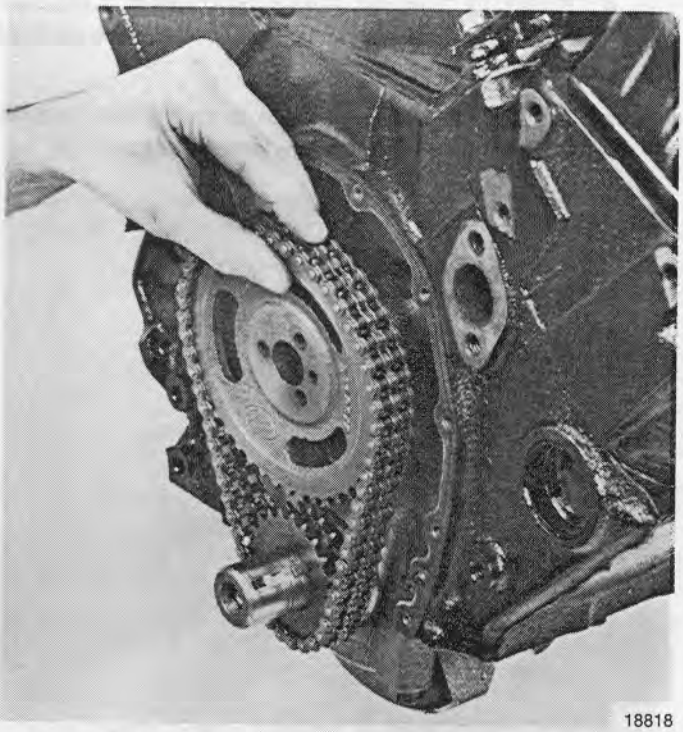
3. Remove camshaft sprocket to camshaft bolts.
4. Remove camshaft sprocket and timing chain together. Sprocket is a light press fit on camshaft. If sprocket does not come off easily, a light blow on lower edge of sprocket (with a plastic mallet) should dislodge the sprocket.
5. If crankshaft sprocket has to be replaced, remove as outlined in "Crankshaft Sprocket/Gear".

CLEANING and INSPECTION

1. Clean all parts in solvent and dry with compressed air.
2. Inspect timing chain for wear or damage.
3. Inspect sprockets for wear or damage.

INSTALLATION

1. If crankshaft sprocket was removed, install as outlined in "Crankshaft Sprocket/Gear".
2. Install timing chain on camshaft sprocket. Hold sprocket vertical with chain hanging down and orient to align marks on camshaft and crankshaft sprockets.



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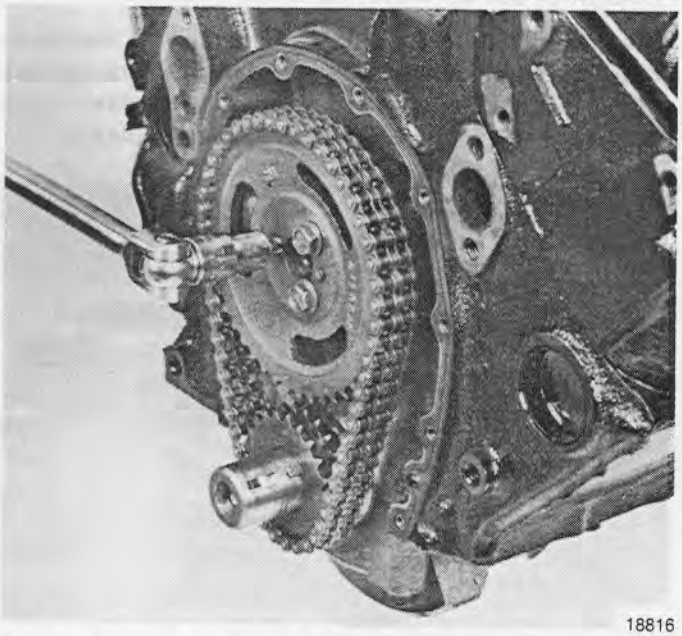
IMPORTANT: Do not attempt to drive sprocket on camshaft, as welsh plug at rear of engine can be dislodged.

3. Draw camshaft sprocket onto camshaft, using the 3 mounting bolts. Torque to 20 lbs. ft. (27.1 N.m).



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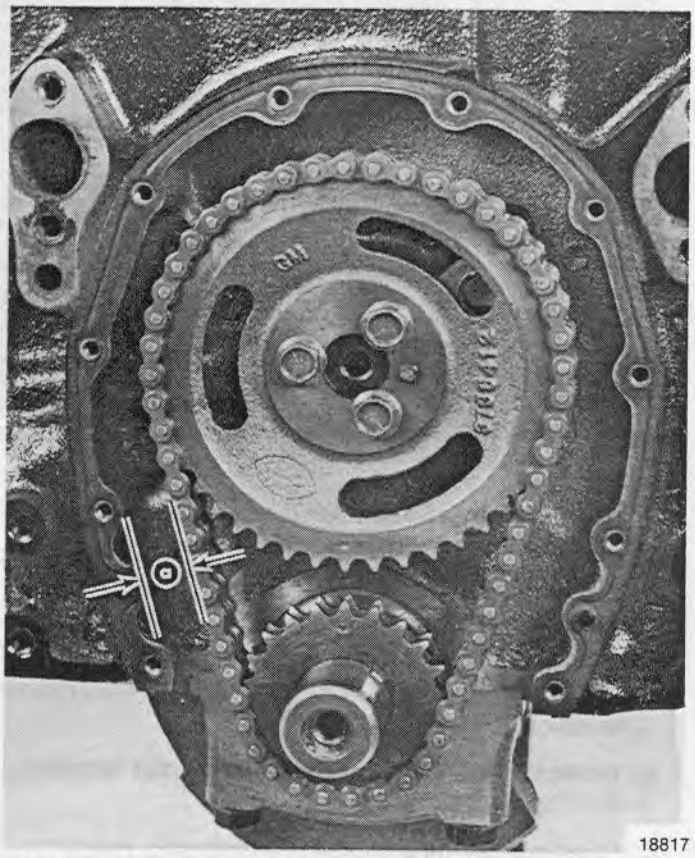
4. Lubricate timing chain with engine oil. Install crankcase front cover and torsional damper as outlined.

CHECKING TIMING CHAIN DEFLECTION

With timing chain and sprockets installed, check timing chain deflection, as follows:

1. Rotate camshaft (in either direction) to place tension on one side of the chain.
2. Establish a reference point on the block (on taut side of chain) and measure from this point to the chain.
3. Rotate camshaft in the opposite direction to slacken the chain, then force chain out with fingers and again measure the distance between reference point and timing chain.
4. The deflection is the difference between these two measurements. If the deflection exceeds specifications, timing chain should be replaced.



18817

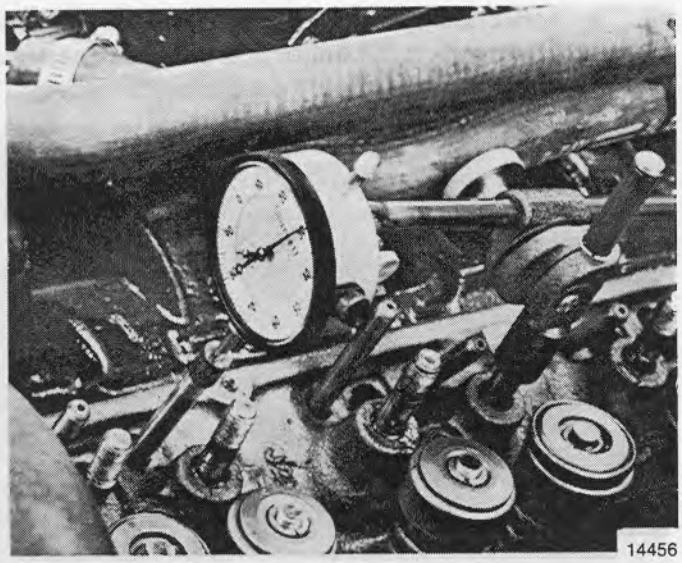
a - Reference Point

Camshaft

MEASURING LOBE LIFT

NOTE: Procedure is similar to checking valve timing. If improper valve operation is indicated, measure lift of each push rod in consecutive order and record readings.

1. Remove valve mechanism as outlined.
2. Position indicator with ball socket adapter Tool J-8520-1 on push rod. Be sure that push rod is in lifter socket.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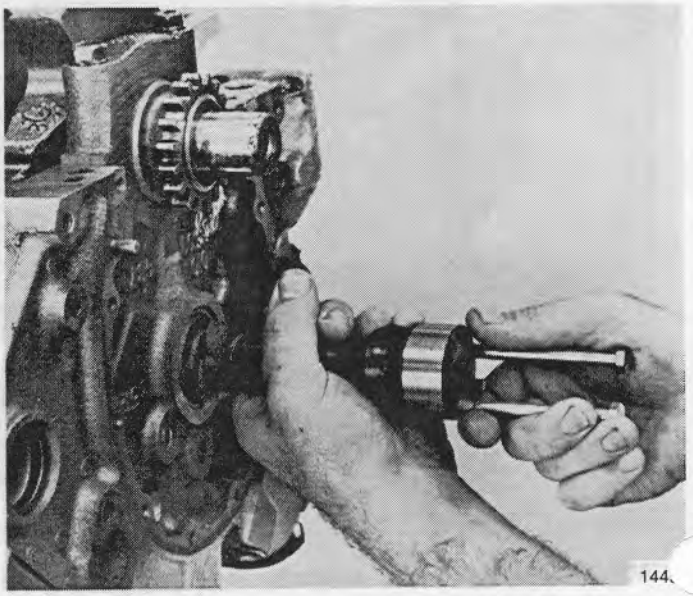
3. Rotate crankshaft damper slowly in direction of rotation until lifter is on heel of cam lobe. At this point, push rod will be in its lowest position.
4. Set dial indicator on zero, then rotate balancer slowly (or attach an auxiliary starter switch and "bump" engine over) until push rod is in fully raised position.
5. Compare total lift, recorded from dial indicator, with "Specifications".
6. Continue to rotate engine until indicator reads zero. This will be a check on accuracy of original indicator reading.
7. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
8. Install and adjust valve mechanism as outlined.

REMOVAL

1. Remove valve lifters as outlined.
2. Remove crankcase front cover as outlined.
3. Remove fuel pump and fuel pump push rod.
4. Remove camshaft as follows:
   a. Refer to "Timing Chain/Sprockets, Left-Hand (Standard) Rotation Engines" to remove chain and sprocket.
   b. Install two 5/16-18 bolts in camshaft sprocket bolt holes and carefully remove camshaft.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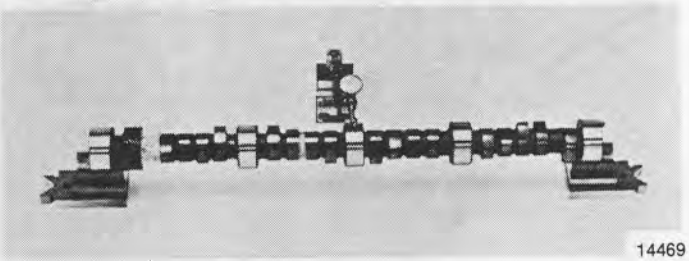
INSPECTION

Measure camshaft bearing journals with a micrometer for out-of-round condition. If journals exceed .001" (.025mm) out-of-round, camshaft should be replaced.

Also check camshaft for alignment with "V" blocks and dial indicator which indicates exact amount camshaft is out-of-true. If out more than .002" (.051mm) (dial indicator reading) camshaft should be replaced.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INSTALLATION

1. Install camshaft as follows:
   a. Install two 5/16-18 bolts in camshaft bolt holes, then lubricate camshaft journals with engine oil and install camshaft, being careful not to damage bearings. Remove the two 5/16-18 bolts.
   b. Install timing chain and sprocket as outlined in "Timing Chain/Sprockets".

Camshaft Bearings

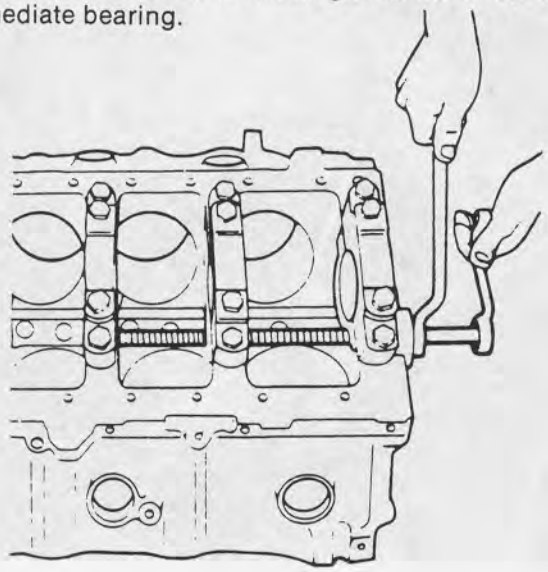
REMOVAL

Camshaft bearings can be replaced while engine is disassembled for overhaul or without complete disassembly. To replace bearings without complete disassembly, remove camshaft and crankshaft, leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Fasten connecting rod against sides of engine so that they will not interfere while replacing camshaft bearings.

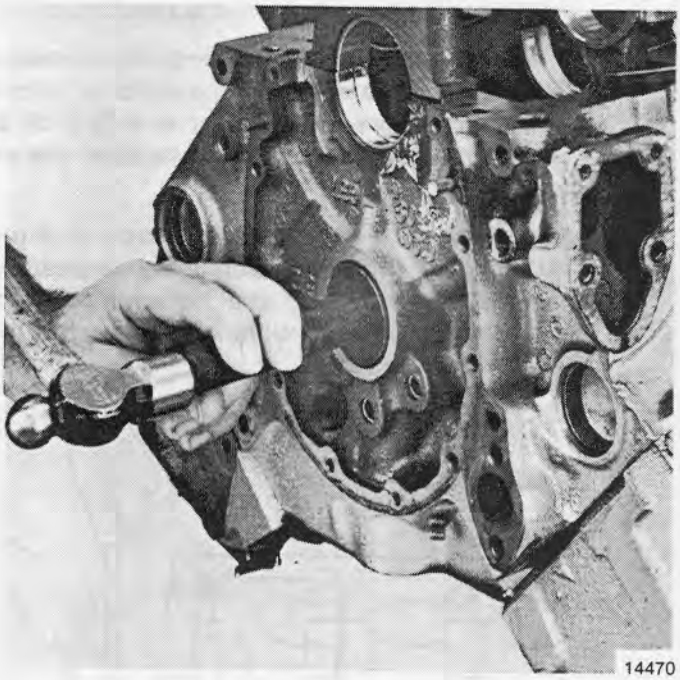
1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.

IMPORTANT: This procedure is based on removal of bearings center of engine first, thus requiring a minimum amount of turns to remove all bearings.

2. Using tool set J-6098-01 (with nut and thrust washer installed to end of threads), position pilot in front camshaft bearing and install puller screw through pilot.
3. Install tool with shoulder toward bearing. Be sure a sufficient amount of threads are engaged.
4. Using 2 wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove tool and bearing from puller screw.
5. Remove remaining bearings (except front and rear) in same manner. It will be necessary to position pilot in rear camshaft bearing to remove rear intermediate bearing.



6. Assemble remover tool on driver handle and remove front and rear camshaft bearings by driving toward center of cylinder block.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INSPECTION

Clean camshaft bearing bores in cylinder block with solvent and blow out with compressed air. Be sure grooves and drilled oil passages are clean.

INSTALLATION

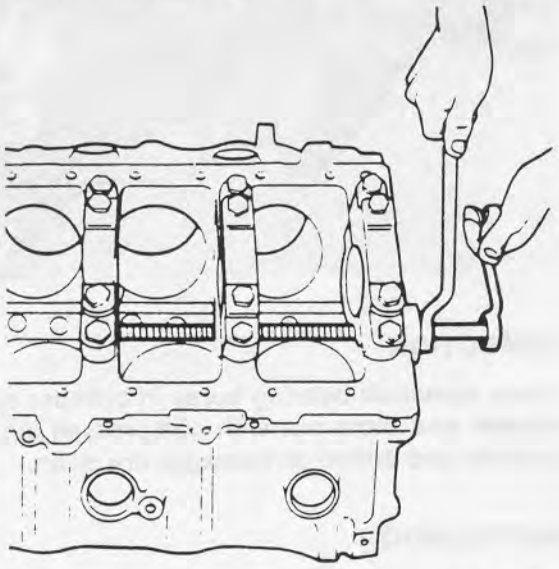
Front and rear bearings must be installed last as pilot will not fit into bearing bores if bearings are installed.

Lubricate outer surface of new camshaft bearings with engine oil to ease installation.

IMPORTANT: All camshaft bearings are not the same. Be sure to install bearing in proper location (indicated by bearing manufacturer) and to position bearings as follows: (Directional references are in reference to engine in its normal operating position.)

Front bearing must be positioned so that oil holes are equal distance from 6 o'clock position in the block. Intermediate and center bearings must be positioned so that oil holes are at the 5 o'clock position (toward left side of block and at a position even with bottom of cylinder bore). Rear bearing must be positioned so that oil hole is at the 12 o'clock position.

1. **Installing Intermediate and Center Bearings:**
   a. Install nut and thrust washer all-the-way onto puller screw, then position pilot in front camshaft bearing bore and insert screw thru pilot.
   b. Index center camshaft bearing, then position appropriate size remover and installer tool in bearing and thread puller screw into tool. Be sure at least 1/2" (13mm) of threads are engaged.
   c. Using 2 wrenches, hold puller screw and turn nut until bearing has been pulled into position. Remove the remover and installer tool and check to ensure that oil hole(s) in bearing are positioned correctly.



   d. Install intermediate bearings in same manner being sure to index bearings correctly. It will be necessary to position pilot in rear camshaft bearing bore to install rear intermediate bearing.
2. **Installing Front and Rear Bearings:**
   a. Install appropriate size remover and installer tool on drive handle.
   b. Index front bearing (as explained in "Important"), and drive it into position with tool. Check position of oil hole(s) in bearing to ensure bearing is positioned correctly.
   c. Install rear bearing in same manner, being sure to index bearing correctly.
3. Install a new camshaft rear plug.

IMPORTANT: Plug must be installed flush to 1/32" (.8mm) deep and must be parallel with rear surface of cylinder block.

4. Install crankshaft and camshaft as outlined.

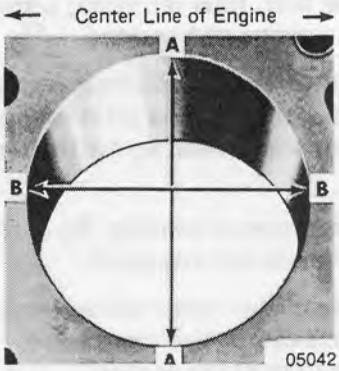
Cylinder Block

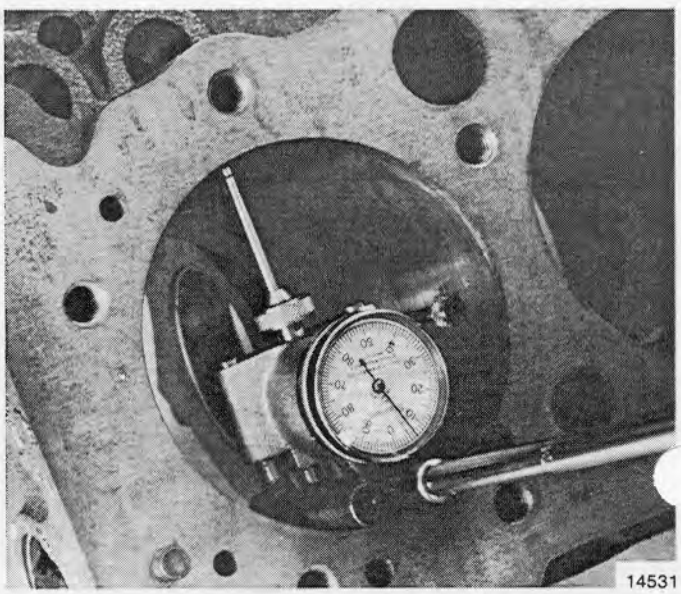
CLEANING and INSPECTION

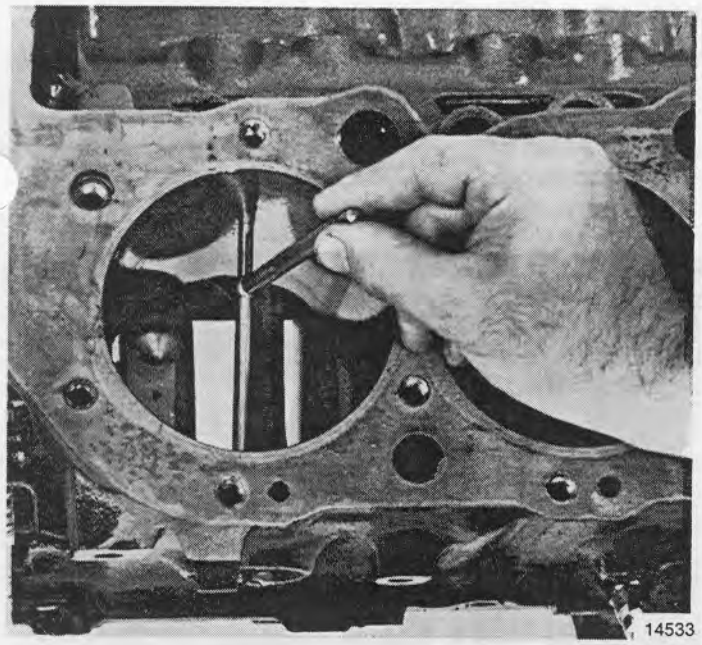
1. Remove all engine components as previously outlined.
2. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.
3. Remove oil gallery plugs and clean all oil passages.

NOTE: These plugs may be removed with a sharp punch, or they may be drilled and pried out.

4. Clean and inspect water passages in cylinder block.
5. Inspect cylinder block for cracks in cylinder walls, water jacket valve lifter bores and main bearing webs.
6. Measure cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator or inside micrometer. Carefully work gauge up and down cylinder to determine taper and turn it to different points around cylinder wall to determine out-of-round condition. If cylinders exceed specifications, boring and/or honing will be necessary.



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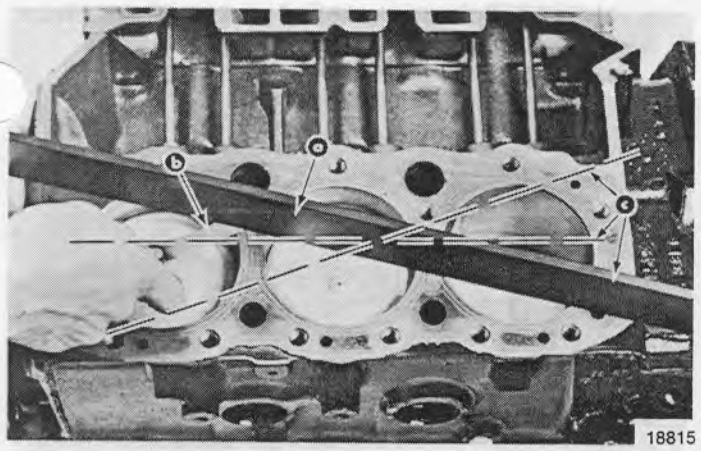
7. Check cylinder head gasket surfaces for warpage with a machinists straight edge and a feeler gauge, as shown. Take measurements diagonally across surfaces (both ways) and straight down center. If surfaces are out-of-flat more than .003" (.07mm) in a 6" area or .007" (.2mm) overall, block must be resurfaced by an automotive machine shop.



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a - Machinists Straight Edge
b - Feeler Gauge
c - Take Measurements Diagonally Across Surface and Straight Down Center

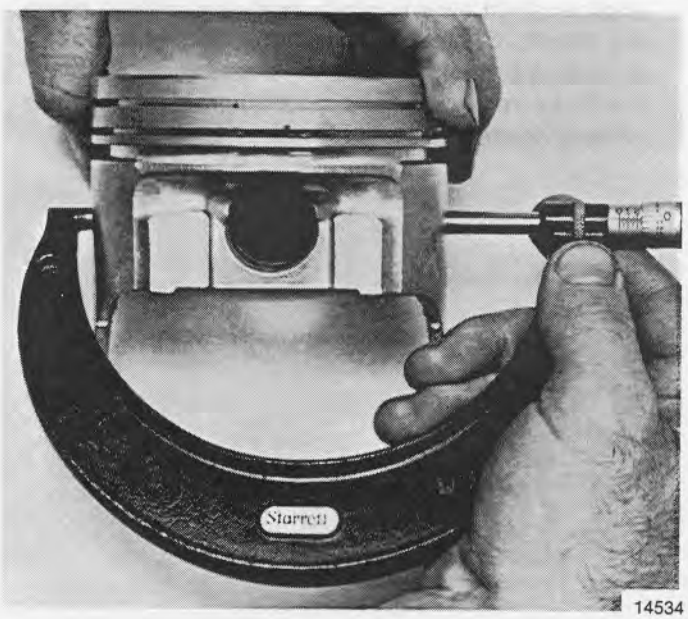
REPAIRS

Cylinder Conditioning:

1. Performance of the following operation depends upon engine condition at time of repair.
2. If cylinder block inspection indicates that block is suitable for continued use (except for out-of-round or tapered cylinders), they can be conditioned by honing or boring.
3. If cylinders have less than .005" (.127mm) taper or wear, they can be conditioned with a hone and fitted with high limit standard size piston. A cylinder bore of less than .005" wear or taper may not clean up entirely when fitted to a high limit piston. To entirely clean up the bore, it will be necessary to rebore for an oversize piston. If more than .005" taper or wear, bore and hone to smallest oversize that will permit complete resurfacing of all cylinders.
4. When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, swab cylinder bores several times with light engine oil and a clean cloth, then wipe with a clean dry cloth.

Cylinder Boring:

1. Before using any type boring bar, clean off top of cylinder block to remove dirt or burrs. This is very important to prevent boring bar tilt, with result that rebored cylinder wall is not at right angles to crankshaft.
2. Measure piston to be fitted with a micrometer, measuring at center of piston skirt and at right angles to piston pin. Bore cylinder to same diameter as piston and hone to give specified clearance.



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IMPORTANT: Hone cylinders as outlined under "Cylinder Honing" and "Piston Selection", following.

3. Carefully observe instructions furnished by manufacturer of equipment being used.

Cylinder Honing:

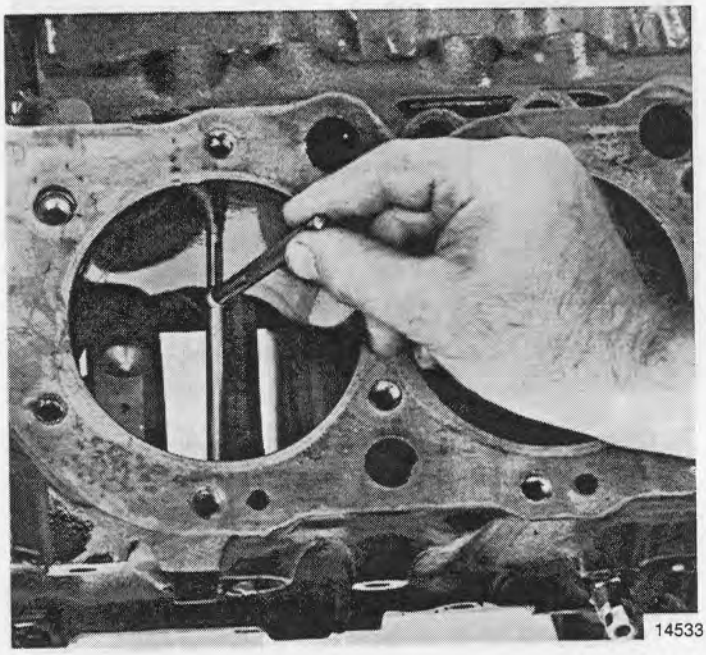
1. Follow hone manufacturer's recommendations for use of hone and cleaning and lubrication during honing.
2. Occasionally, during the honing operation, thoroughly clean cylinder bore and check piston for correct fit in cylinder.
3. When finish-honing a cylinder bore to fit a piston, move hone up-and-down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of approximately 30° to cylinder bore. Finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
4. Permanently mark piston (for cylinder to which it has been fitted) and proceed to hone cylinders and fit remaining pistons.

IMPORTANT: Handle pistons with care and do not attempt to force them through cylinder, as this type piston can be distorted by careless handling.

5. Thoroughly clean cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any abrasive material remains in cylinder bores, it will rapidly wear new rings and cylinder bores in addition to bearings lubricated by the contaminated oil. Swab bores several times with light engine oil on a clean cloth, then wipe with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean remainder of cylinder block to remove excess material spread during honing operation.

Piston Selection:

1. Check USED piston to cylinder bore clearance as follows:
   a. Measure "cylinder bore diameter" with a telescope gauge 2-1/2" (64mm) from top of cylinder bore.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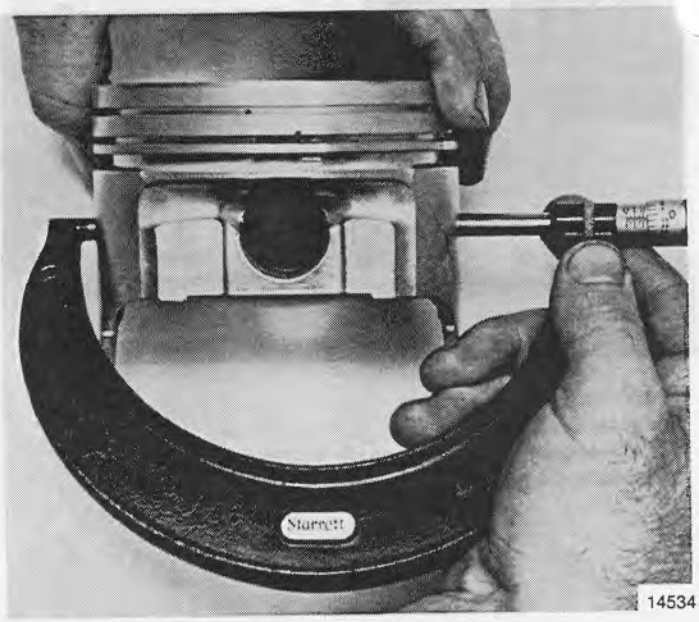
   b. Measure "piston diameter" at skirt across center line of piston pin.



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   c. Subtract piston diameter from cylinder bore diameter to determine "piston-to-bore clearance".
   d. Determine if "piston-to-bore clearance" is in acceptable range shown in "Specifications".

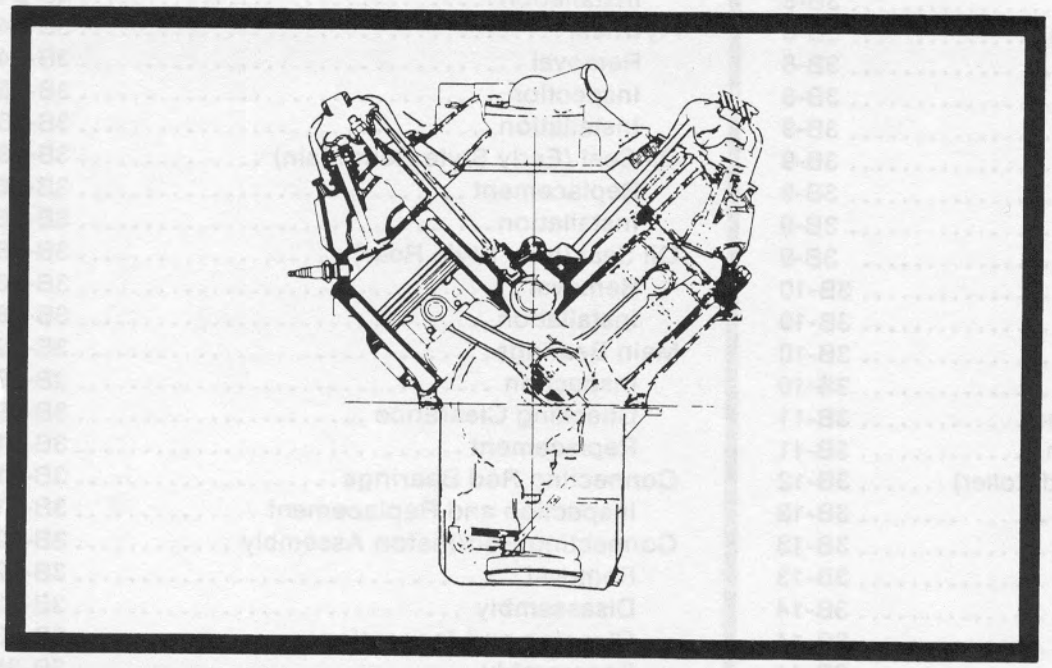
2. If used piston is not satisfactory, determine if a new piston can be selected to fit cylinder bore within acceptable range.
3. If cylinder bore must be reconditioned, measure new piston diameter (across centerline of piston pin), then hone cylinder bore to correct clearance (preferable range).
4. Mark piston to identify cylinder for which it was fitted.

REPLACEMENT PART INFORMATION

If replacement of cylinder block is necessary, the following must be performed:

1. Retain oil filter adaptor assembly and related parts for use with new engine.
2. If engine being replaced has a remote oil filter, check the cylinder block being replaced to determine method used to attach cylinder block adaptor to cylinder block.

ENGINE MECHANICAL



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B

V-6 GM 262 CID (4.3L)

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Torque Specifications

Fastener Location	Lbs. Ft. (N·m)	Lbs. In. (N·m)
Camshaft Sprocket	20 (27)	
Conn. Rod Cap	45 (61)	
Crankcase Front Cover		80 (9)
Cylinder Head	75 (100)	
Distributor Clamp	20 (27)	
Exhaust Manifold	20 (27)	
Flywheel/Coupler Nut (NOTE 1)	40 (54)	
Flywheel Housing	30 (4)	
Intake Manifold	40 (54)	
Main Bearing Cap	85 (115)	
Oil Filter	25 (34)	
Oil Filter By-Pass Valve		80 (9)
Oil Pan to Crankcase Nut (5/16-18)		165 (19)
Oil Pan to Crankcase Screw (1/4-20)		80 (9)
Oil Pan Drain Plug	20 (27)	
Oil Pump	65 (88)	
Oil Pump Cover		80 (9)
Rocker Arm Nut	20 (27)	
Rocker Arm Cover		60 (7)
Spark Plug		180 (20)
Torsional Damper	60 (81)	
Water Pump	30 (41)	
Flywheel Screw	75 (100)	
Engine Coupler Screw	35 (48)	
Hydraulic Lifter Restrictor Retainer Screws (Roller Cam)	12 (16)	

NOTE 1: Earlier engines had studs in crankshaft to retain flywheel and coupler.

NOTE 2: Flywheel retained by screws, end coupler retained by screws to flywheel.

NOTE 3: Only engine equipped with electric fuel pump.

Special Tools

MERCURY MARINE SPECIAL TOOLS	
91-35547	Engine Coupler Wrench
91-66273	Rocker Stoppers
91-24697	Piston Ring Expanders

KENT-MOORE SPECIAL TOOLS

Can be ordered from: Kent-Moore Tools, Inc.
29784 Little Mack
Roseville, MI 48066
Phone: (313) 774-9500

J-8062	Valve Spring Compressor (Cylinder Head Off)
J-8101	Valve Guide Bore Cleaning Brush
J-8358	Valve Seat & Valve Face Cleaning Brush
J-5830-1	Oversize Valve Guide Reamer (.003")
J-5830-6	Oversize Valve Guide Reamer (.006")
J-9345-1	Oversize Valve Guide Reamer (.010")
J-8080	Crankshaft Upper Bearing Shell Remover & Installer
J-8369	Oil Suction Pipe Installer
J-5825	Crankshaft Sprocket Remover
J-5239	Connecting Rod Guide Set for Cap Screw Rods
J-5802-01	Rocker Arm Stud Remover
J-6880	Rocker Arm Stud Installer
J-5590	Crankshaft Sprocket Installer
J-8037	Piston Ring Compressor
J-25087	Oil Pressure Gauge
J-3049	Valve Lifter Remover
J-5790	Hydraulic Valve Lifter Leakdown Tester
J-23394	Front Intake Manifold Bolt Wrench
J-5250	Timing Chain Cover Oil Seal Installer
J-4160-A	Hydraulic Valve Lifter Plunger Remover
J-5892	Valve Spring Compressor (Cylinder Head on Block)
J-8089	Carbon Removing Brush
J-6098	Camshaft Bearing Remover and Installer
J-8056	Valve Spring Tester
J-23994	Valve Seal Leak Tester
J-8520	Cam Lobe Lift Indicator
J-24086-20	Piston Remover Base
J-24086-8	Piston Pin Remover
J-24086-9	Piston Pin Installer
J-22509	Intake Valve Seal Installer

LUBRICANTS - SEALERS	
92-32609-1	Quicksilver Loctite
92-34227	Quicksilver Perfect Seal
92-42649A1	Quicksilver Needle Bearing Assembly Lubricant
92-91601-1	Quicksilver RTV Sealer

Engine Specifications

Model	175/185/4.3L/205/4.3LX
Displacement	262 (4.3 Liter)
Engine Type Number of Cylinders	V-6

Cylinder Bore:

Diameter			3.9995" - 4.0025" (101.6 - 101.7)
Out of Round	Production		.001" (.025) Max.
	Service		.002" (.051) Max.
Taper	Production	Thrust Side	.0005" (.0127) Max.
		Relief Side	.001" (.025) Max.
	Service		.001" (.025) Max.

Piston:

Clearance	Production	.0007" - .0017" (.0178 - .0432)
	Service	.0027" (.0686) Max.

Piston Ring: **(1) HI Production Limit**

Compression	Groove Side Clearance	Production	Top	.0012" - .0032" (.0305 - .0813)
			2nd	.0012" - .0032" (.0305 - .0813)
		Service		(1) + .001" (.025)
	Gap	Production	Top	.010" - .020" (.254 - .508)
			2nd	.010" - .025" (.254 - .635)
		Service		(1) + .010" (.254)
Oil	Groove Side Clearance	Production		.002" - .007" (.051 - .178)
		Service		(1) + .001" (.025)
	Gap	Production		.015" - .055" (.381 - 1.397)
		Service		(1) + .010" (.254)

Piston Pin:

Diameter		.9270" - .9273" (23.5458 - 23.5534)
Clearance	Production	.00025" - .00035" (.00635 - .00889)
	Service	.001" (.025) Max.
Fit in Rod		.0008" - .0016" (.0203 - .0406) Interference

Crankshaft:

Main Journal	Diameter	No. 1	2.4484" - 2.4493" (62.1894 - 62.2122)
		No. 2, 3	2.4481" - 2.4490" (62.1817 - 62.2046)
		No. 4	2.4479" - 2.4488" (62.1767 - 62.1995)
	Taper	Production	.0002" (.0051) Max.
		Service	.001" (.025) Max.
	Out of Round	Production	.0002" (.0051) Max.
		Service	.001" (.025) Max.
Main Bearing Clearance	Production	No. 1	.0008" - .0020" (.0203 - .0508)
		No. 2, 3	.0011" - .0023" (.0279 - .0584)
		No. 4	.0017" - .0032" (.0432 - .0813)
	Service	No. 1	.001" - .0015" (.0254 - .0381)
		No. 2, 3	.001" - .0025" (.0254 - .0635)
		No. 4	.0025" - .0035" (.0635 - .0889)
Crankshaft End Play			.002" - .006" (.051 - .152)
Connecting Rod Journal	Diameter		2.2487" - 2.2497" (57.117 - 57.142)
	Taper	Production	.0005" (.0127) Max.
		Service	.001" (.025) Max.
	Out of Round	Production	.0005" (.0127) Max.
		Service	.001" (.025) Max.
Rod Bearing Clearance		Production	.0013" - .0035" (.0330 - .0889)
		Service	.003" (.0762) Max.
Rod Side Clearance			.008" - .014" (.203 - .356)
Crankshaft Runout			.0015" (.0381) Max.

Camshaft and Drive:

Lobe Lift ±.002" (.051mm)	Intake	.273 (6.9342)
	Exhaust	.273 (6.9342)
Roller Cam	Intake	.269
	Exhaust	.273 (6.9342)
Journal Diameter		1.8682" - 1.8692" (47.452 - 47.478)
Journal Out-of-Round		.001" (.025) Max.
Camshaft End Play		.004" - .012" (.102 - .304)
Timing Chain Deflection		3/8" (9.5) from Taut Position [3/4" (19.1) Total]

Valve System:

Lifter Type			Hydraulic
Rocker Arm Ratio			1.50 to 1
Valve Lash (Intake & Exhaust)			1 Turn Down from Zero Lash
Face Angle (Intake & Exhaust)			45°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			.002" (.051) Max.
Seat Width		Intake	1/32" - 1/16" (.79 - 1.59)
		Exhaust	1/16" - 3/32" (1.59 - 2.38)
Stem Clearance	Production	Intake	.0010" - .0027" (.0254 - .0686)
		Exhaust	.0010" - .0027" (.0254 - .0686)
	Service	Intake	.0037" (.0940)
		Exhaust	.0047" (.1194)
Valve Spring	Free Length		2.03" (51.6)
	Pressure Lbs. @ In. (NOTE 1)	Closed @ 1.70" (43.16)	76 - 84 Lbs. (34.5 - 38.1kg)
		Open @ 1.25" (31.75mm)	194 - 206 Lbs. (88.1 - 93.5kg)
	Installed Height		1-23/32" (43.7)
Damper	Free Length		1.86" (47.24)
	Approximate No. of Coils		4

Cylinder Head:

Gasket Surface Flatness	.003" (.076) in 6" (15.24cm) .007" (.178) Overall Maximum

Flywheel:

Runout	.008" (.203) Max.

General

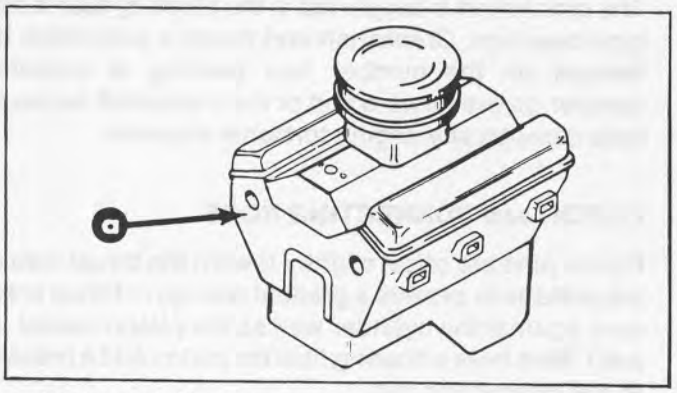
Some repairs, that are listed in this section, must be completed with engine removed from boat. Engine removal depends upon type of repair and boat design. Place engine on repair stand for major repairs.

Lubricate all moving parts (during reassembly) with engine oil. Apply Perfect Seal on threads of and under head of cylinder head bolts and on threads of all cylinder block external bolts, screws and studs.

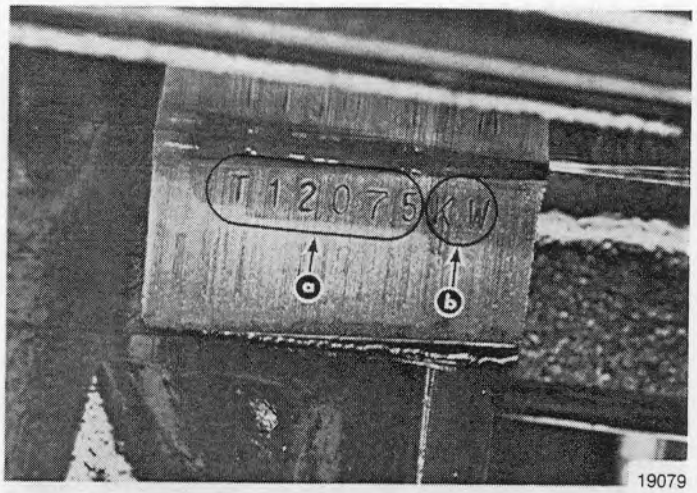
ENGINE IDENTIFICATION

The MerCruiser Model can be determined by looking at the last two letters of the engine code stamped into the cylinder block. This code number is stamped on all MerCruiser Power Packages and replacement partial engines but not replacement cylinder block assemblies.

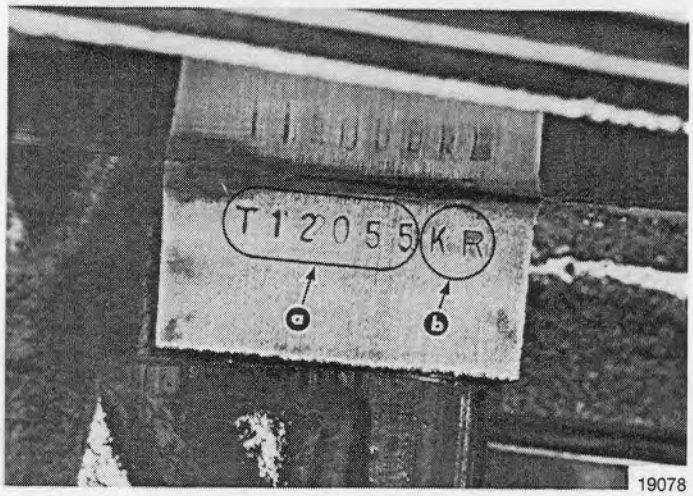
If the engine serial number, and/or model decals are missing, the engine code letters may help in determining the engine model.



a - Engine Code Numbers Located
Front, Starboard Side, Near Cylinder Head Mating Surfaces



19079



19078

a - Engine Code
b - Last Two Letters - 185 =KW
175-4.3L =KR
4.3L Gen. II =KP
205/4.3LX/4.3LX Gen. II =KR

Service Replacement Engine XXG

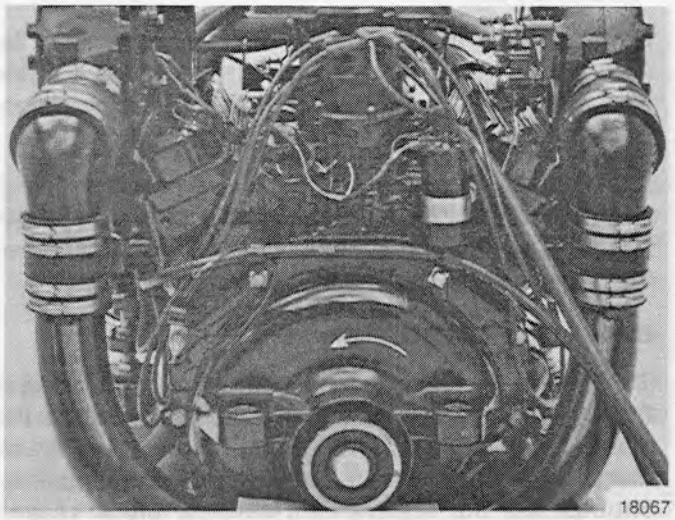
CYLINDER HEAD IDENTIFICATION

ENGINE ROTATION

Engine rotation is determined by observing flywheel rotation from the rear (stern drive end) of the engine looking forward (water pump end).

Propeller rotation is not necessarily the same as engine rotation.

When ordering replacement engines, short blocks or parts for engines, be certain to check engine rotation. Do not rely on propeller rotation in determining engine rotation.



Left Hand Rotation

CRANKSHAFT

The crankshaft is supported in the block by four insert type bearings. Crankshaft end thrust is controlled by flanges on the number four bearing. A torsional damper on the forward end of the crankshaft serves to help dampen any engine torsional vibration.

PISTON and CONNECTING RODS

Piston pins are offset slightly toward the thrust side of the pistons to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins have a floating fit in the piston and a press fit in the connecting rod.

Connecting rods are made of forged steel and are connected to the crankshaft thru insert type bearings.

CAMSHAFT and DRIVE

Camshaft is supported by four bearings, which are pressed into the block, and is driven at one-half crankshaft speed by a timing chain and sprockets.

The valve train is actuated by a steel camshaft for roller lifters, and, on earlier models, a cast iron camshaft for flat style lifters. A helical gear on the aft end of th camshaft drives the distributor and oil pump, while an eccentric cam on the front of the camshaft actuates the fuel pump.

CYLINDER HEAD

The cylinder heads are made of cast iron and have individual intake and exhaust ports for each cylinder.

Stainless steel/graphite head gaskets are used to retard corrosion, and provides superior sealing. Valve guide and exhaust valve seat inserts are used.

VALVE TRAIN

The valves and valve springs are of a heavy-duty design to withstand the high engine speeds encountered. Valve tips have been hardened to extend valve life. Exhaust valve rotators are used to help extend valve life.

Roller type hydraulic valve lifters, (flat lifters on earlier models) ride on the camshaft lobes and transmit the thrust of the lobes to the push rods which in turn actuate the valves thru the rocker arm.

In addition to transmitting thrust of the cam lobes, the hydraulic lifters also serves to remove any clearance (lash) from the valve train to keep all parts in constant contact.

The valve lifters also are used to lubricate the valve train bearing surfaces.

Roller lifters are restrained from rotating by guide plates located in the valley.

INTAKE MANIFOLD

The manifold is of the single level design. All passages are of approximately equal length to assure more even fuel-air mixture to the cylinders.

LUBRICATION SYSTEM

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rods, camshaft bearings and valve lifters, and is supplied under controlled volume to the push rods and rocker arms. All other moving parts are lubricated by gravity flow or splash.

A positive displacement gear-type oil pump is mounted on the rear main bearing cap and is driven by an extension shaft from the distributor (which is driven by the camshaft). Oil from the bottom of the pump in the rear of the oil pan is drawn into the oil pump through an oil pickup screen and pipe assembly.

If screen should become clogged, a relief valve will open and continue to allow oil to be drawn into system. Once the oil reaches the pump, the pump forces the oil thru the lubrication system. A spring loaded relief valve in the pump limits the maximum pump output pressure.

After leaving the pump, the pressurized oil flows thru a full-flow oil filter.

Some of the oil, after leaving the oil cooler and/or filter, is routed to the No. 4 crankshaft main bearing. The remainder of the oil is routed to the main oil gallery, which is located above the camshaft and runs the entire length of the block. From the main oil gallery, the oil is routed thru individual oil passages to an annular groove in each camshaft bearing bore. Some of the oil is then used to lubricate camshaft bearings. The remainder of the oil is routed to the valve lifter oil galleries and No. 1, 2, and 3 crankshaft main bearings by means of individual oil passages which intersect with the annular grooves.

The camshaft bearings have holes which align with the oil passages or annular grooves in the block and allow oil to flow in between the bearings and the camshaft journals. The oil that is forced out the front end of the No. 1 camshaft bearing drains down onto camshaft drive and keeps it lubricated.

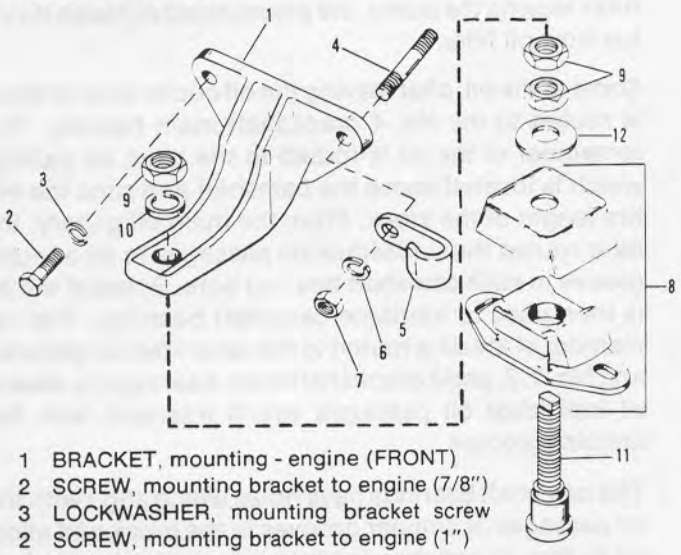
The oil which reaches the crankshaft main bearings is forced thru a hole in the upper half of each bearing and flows in-between the bearings and the crankshaft journals. Some of the oil is then routed to the connecting rod bearings thru grooves in the upper half of the crankshaft main bearings and oil passages in crankshaft. Oil which is forced out the ends of the connecting rod bearings and crankshaft main bearings is splashed onto the camshaft, cylinder walls, pistons and piston pins, keeping them lubricated. Oil which is forced out the front end of the No. 1 crankshaft main bearing also assists in lubricating the camshaft drive.

Oil which reaches the valve lifters oil galleries is forced into each hydraulic valve lifter thru holes in the side of the lifter. From here, the oil is forced thru the metering valve in each of the lifters (which controls the volume of oil flow) and then up thru the push rods to the rocker arms. A hole in each rocker arm push rod seat allows the oil to pass thru the rocker arm and lubricate the valve train bearing surfaces. After lubricating valve train, oil drains back to the oil pan thru oil returns holes in the cylinder head and block.

The distributor shaft and gear also is lubricated by the oil flowing thru the right valve lifter oil gallery. Fuel pump push rod is lubricated by oil thrown off from the camshaft eccentric.

Front Mounts

RUBBER MOUNT

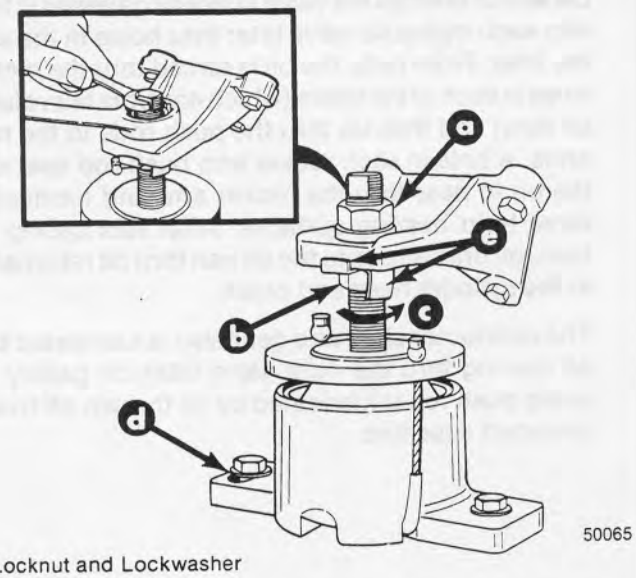


1 BRACKET, mounting - engine (FRONT)
2 SCREW, mounting bracket to engine (7/8")
3 LOCKWASHER, mounting bracket screw
2 SCREW, mounting bracket to engine (1")
3 WASHER, mounting bracket screw
4 STUD, mounting bracket to engine
5 CLIP, wiring harness
6 LOCKWASHER, mounting bracket stud
7 NUT, mounting bracket stud
8 BASE, engine mount
9 NUT, jam - engine mount base
10 LOCKWASHER, mounting bracket
11 STUD, engine mounting
12 WASHER, support
13 TAB WASHER

Starboard

FLUID MOUNT

IMPORTANT: Fluid Mount — You MUST use wrench on mount stud wrench-flat, to prevent twisting and damaging internal components of the mount, whenever adjustments, loosening, or tightening are performed. DO NOT turn (reposition) base of mount without locknut "a" being loose.

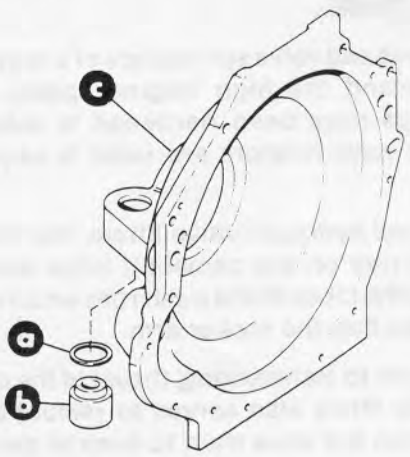


50065

a - Locknut and Lockwasher
b - Adjustment Nut
c - Turn Adjustment Nut in this Direction (Counterclockwise) to Raise Front of Engine
d - Slotted Hole Toward Front of Engine. Attach Mounts to Stringers, Using 3/8 in. (9mm) Lag Bolts
e - Tab Washer

Rear Mounts/Flywheel Housing

1. Inspect mounts for tears in rubber bonding to metal.
2. If mount must be replaced, press mounts out and retain spacer.



a - Spacer
b - Mount
c - Flywheel Housing

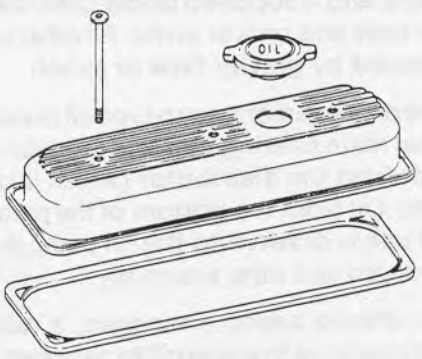
3. Install spacer into housing and press mount into housing.

Rocker Arm Cover

REMOVAL

It may be necessary to remove exhaust manifold before removing rocker arm cover. Also remove any component that will interfere with the removal of the manifold or rocker arm cover.

1. Remove rocker arm cover attaching hardware.



2. Disconnect crankcase ventilation hoses.

IMPORTANT: DO NOT pry rocker arm cover loose. Gaskets, which adhere to cylinder head and rocker arm cover, may be sheared by bumping end of rocker arm cover from the rear with palm of hand or a rubber mallet.

3. Remove rocker arm cover.

INSTALLATION

1. Clean sealing surfaces on cylinder head and rocker arm cover with degreaser.
2. Install rocker arm covers, as follows:
   a. Place new rocker arm cover gasket in position in rocker arm cover.
   b. Install rocker arm cover and secure with screws. Torque to 60 lbs. in. (7 N.m)
3. Connect crankcase ventilation hoses to rocker arm covers.
4. Install exhaust manifolds.
5. Reinstall any items removed from manifolds.
6. Start engine and check for leaks.

Intake Manifold

REMOVAL

1. Drain engine cooling system.
2. Disconnect hoses from thermostat housing.
3. Disconnect crankcase ventilation hoses from rocker arm covers.
4. Disconnect throttle cable from carburetor. Remove fuel line running between fuel pump and carburetor.

IMPORTANT: Do not crank engine over after distributor has been removed.

5. Remove distributor cap and mark position of rotor on distributor housing. Also, mark position of distributor housing on intake manifold. Remove distributor.
6. Remove other ignition components.
7. Disconnect wire from oil pressure sending unit and remove sending unit.
8. Disconnect any other items that will prevent removal of manifold.

IMPORTANT: It may be necessary to pry intake manifold away from cylinder heads and block, in next step. Use extreme care to prevent damage to sealing surfaces.

9. Remove intake manifold screws, then remove intake manifold and carburetor assembly.

NOTE: If intake manifold requires replacement, transfer carburetor and other related parts to new manifold.

CLEANING and INSPECTION

1. Clean gasket material from all mating surfaces.

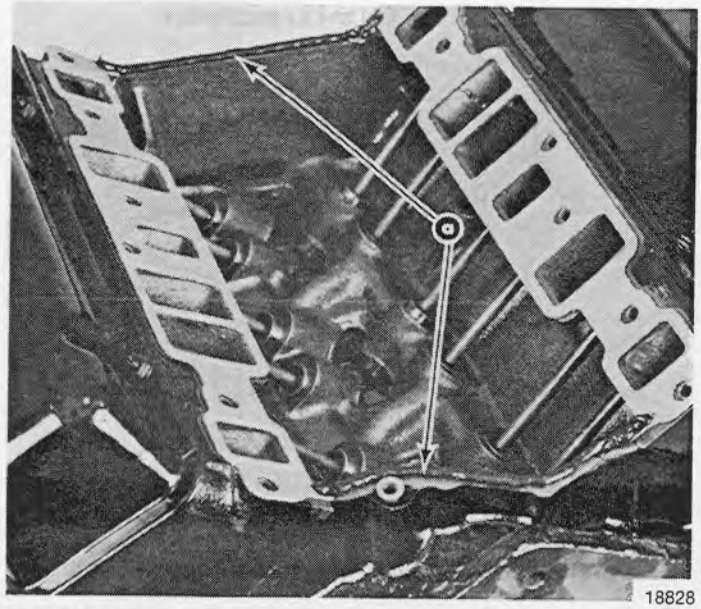
IMPORTANT: When cleaning cylinder head mating surface, do not allow gasket material to enter engine crankcase.

2. Inspect manifold for cracks or scratches. Machined surfaces must be clean and free of all marks, or deep scratches or leaks may result.
3. Check intake passages for varnish buildup or other foreign material. Clean as necessary.

INSTALLATION

IMPORTANT: When installing intake manifold gaskets, in next step, be sure to do the following: Be sure to install gasket with marked side up. Both gaskets are identical.

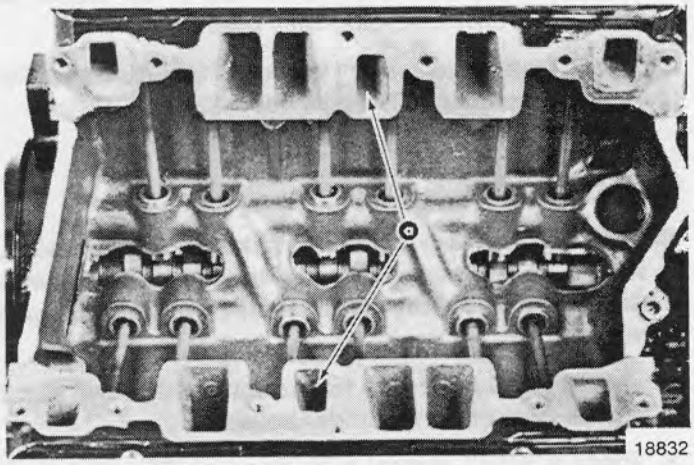
1. Apply Perfect Seal to intake manifold gaskets and install gaskets on cylinder heads.
2. Place a 3/16" (5mm) wide bead of RTV sealer on block. Extend the bead 1/2" (13mm) up each gasket to seal corners.



a - RTV Sealer (Typical Both Ends)

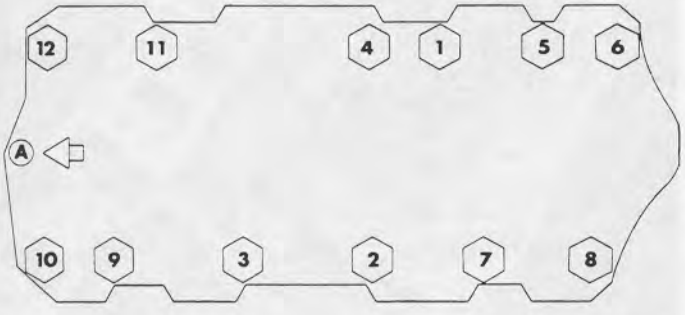
IMPORTANT: All MerCruiser V-6 G.M. engines that have "automatic" carburetor chokes must use an intake gasket that has an opening for the exhaust crossover port in the intake manifold.

Without this opening the "automatic" choke will not operate properly. The choke will remain "on" longer causing rough engine operation and wasted fuel.



a - Exhaust Crossover Port Opening

3. Carefully install manifold assembly and torque bolts to 40 lbs. ft. (54 N.m) in sequence.



a - Front

4. Connect wire to water temperature sending unit.
5. Reconnect hoses to thermostat housing, tighten securely.
6. Install fuel line to carburetor and fuel pump. Torque to 18 lb. ft. (24 N·m).
7. Connect throttle cable to carburetor.
8. Connect crankcase ventilation hoses to rocker arm covers.
9. Install distributor. Position rotor and housing to align with marks made during removal. Tighten securely, then install distributor cap.
10. Install other ignition components and reconnect wires.
11. Coat threads of oil pressure sending unit with Perfect Seal and install.
12. Connect wire to sending unit.
13. Reconnect any other items which were disconnected from manifold during the removal.
14. Start engine. Adjust ignition timing and carburetor. Check hose connections, gaskets and seals for leaks.
15. Inspect fuel line connections for fuel leaks.

Rocker Arm/Push Rod

REMOVAL

1. Remove rocker arm covers.
2. Remove rocker arm components, rocker arms and push rods.

IMPORTANT: Place rocker arms, rocker arm components and push rods in a rack for reinstallation in the same locations.

CLEANING and INSPECTION

1. Clean parts with solvent and dry with compressed air.
2. Inspect all contact surfaces for wear. Replace all damaged parts.

INSTALLATION

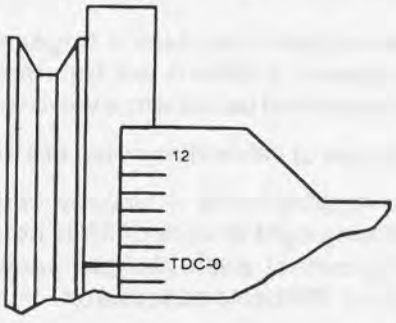
IMPORTANT: When installing rocker arms and rocker arm balls, coat bearing surfaces of rocker arms and rocker arm balls with engine oil.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.
3. Valve lash can be adjusted either with engine stopped or running.

ADJUSTMENT - ENGINE STOPPED

With valve cover removed, adjust valves when lifter is on low part of camshaft lobe, as follows:

1. Crank engine with starter or turn over in normal direction of rotation until mark on torsional damper lines up with center "O" mark on timing tab, and engine is in No. 1 firing position. This may be determined by placing fingers on No. 1 valve as mark on damper comes near "O" mark on timing mark. If valves move as mark comes up to timing tab, engine is in No. 6 firing position and should be turned over one more time to reach No. 1 position.

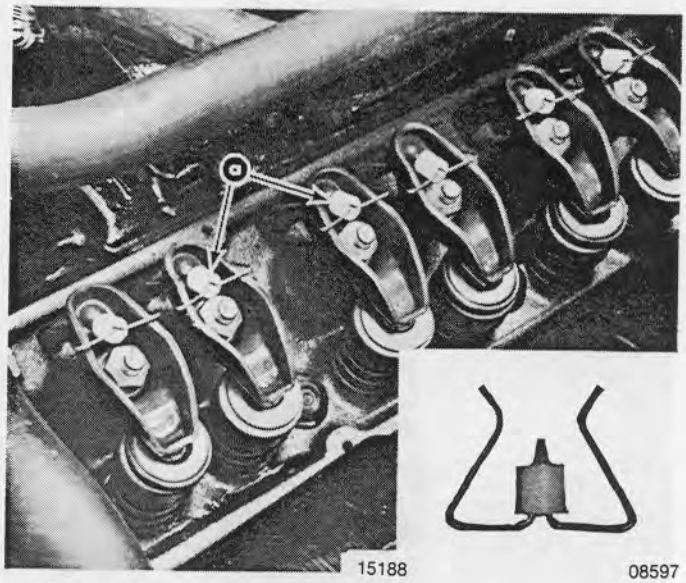


2. With engine in No. 1 firing position, as determined above, the following valves may be adjusted.
   Exhaust - 1, 5, 6
   Intake - 1, 2, 3
3. Back out adjusting nut until lash is felt at push rod, then turn in adjusting nut until all lash is removed. This can be determined by moving push rod up-and-down while turning adjusting nut until all play is removed.

4. Hydraulic lifters now can be adjusted by tightening adjustment nut an additional 1-turn. No other adjustment is required.
5. Crank engine one revolution until pointer "O" mark and torsional damper mark are again in alignment. This is No. 6 firing position. With engine in this position, the following valves may be adjusted as previously outlined.
   Exhaust - 2, 3, 4
   Intake - 4, 5, 6
6. Install rocker arm covers.

ADJUSTMENT - ENGINE RUNNING

1. After engine has reached normal operating temperature, remove valve covers and install rocker stoppers.



a - Rocker Stoppers

2. With engine running at idle, back rocker arm nuts off (one at a time) until valve rocker arm starts to clatter.
3. Turn rocker arm nut down until clatter just stops.
4. Turn nut down 1/4 additional turn and pause 10 seconds until engine runs smoothly. Repeat until nut has been turned down 1-turn from the zero lash position.

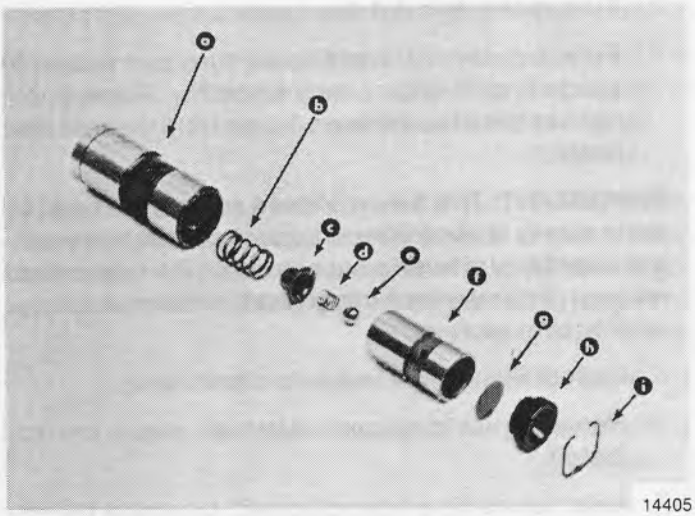
IMPORTANT: This 1-turn preload adjustment must be done slowly to allow lifter to adjust itself, thus preventing possibility of interference between inlet valve head and top of piston which might result in internal damage and/or bent push rods.

5. Repeat Steps 2-3-4 to adjust other valves.
6. Remove rocker stoppers after all valves are adjusted.
7. After valves have been adjusted, complete the following:
   a. Install new gasket and install covers. Torque to 60 lbs. in. (7 N.m).
   b. Adjust carburetor idle speed and mixture.
   c. Start engine and check for leaks.

Hydraulic Valve Lifters (Flat and Roller Lifter)

24580

Roller Hydraulic Valve Lifter Assembly



14405

a - Lifter Body
b - Plunger Spring
c - Check Ball Retainer
d - Check Ball Spring
e - Check Ball
f - Plunger
g - Metering Valve
h - Push Rod Seat
i - Push Rod Seat Retainer

Flat Hydraulic Valve Lifter Assembly

Hydraulic valve lifters require little attention. Lifters are extremely simple in design. Normally, readjustments are not necessary and servicing requires only that care and cleanliness be exercised in the handling of parts.

LOCATING NOISY LIFTERS

Locate a noisy valve lifter by using a piece of garden hose approximately 4 ft. (1.2m) in length. Place one end of hose near end of each intake and exhaust valve, with other end of hose to the ear. In this manner, sound is localized, making it easy to determine which lifter is at fault.

Another method is to place a finger on face of valve spring retainer. If lifter is not functioning properly, a distinct shock will be felt when valve returns to its seat.

General type of valve lifter noise are as follows:

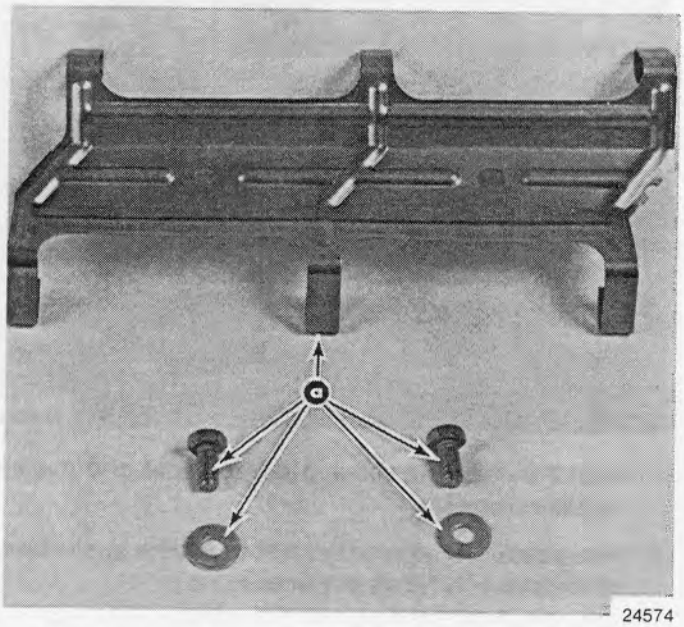
1. Hard rapping noise -- Usually caused by plunger becoming tight in bore of lifter body so that return spring cannot push plunger back up to working position. Probable causes are:
   a. Excessive varnish or carbon deposit, causing abnormal stickiness.
   b. Galling or "pick-up" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedged between plunger and lifter body.
2. Moderate rapping noise -- Probable causes are:
   a. Excessively high leakdown rate.
   b. Leaky check valve seat.
   c. Improper adjustment.
3. General noise throughout valve train -- This will, in most cases, be a definite indication of insufficient oil supply or improper adjustment.
4. Intermittent clicking -- Probable causes are:
   a. A piece of dirt momentarily caught between ball seat and check valve ball.
   b. In rare cases, ball itself may be out-of-round or have a flat spot.
   c. Improper adjustment.

In most cases, where noise exists in one or more lifters, all lifter units should be removed, disassembled, cleaned in solvent, reassembled and reinstalled in engine. If dirt, corrosion, carbon, etc, is shown to exist in one unit, it more likely exists in all the units, thus it would only be a matter of time before all lifters caused trouble.

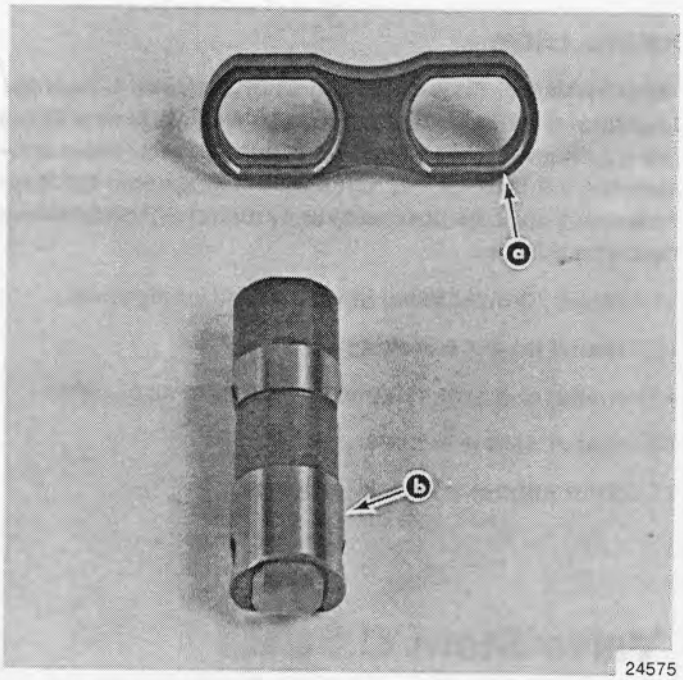
REMOVAL

1. Remove intake manifold.
2. Remove guide plates on roller lifter models.
3. Remove valve mechanism.

NOTE: Engines equipped with roller lifters have additional valve train components shown below.



a - Lifter Restrictor Retainer and Fasteners



a - Roller Lifter Restrictor
b - Roller Lifter

4. Remove valve lifters.

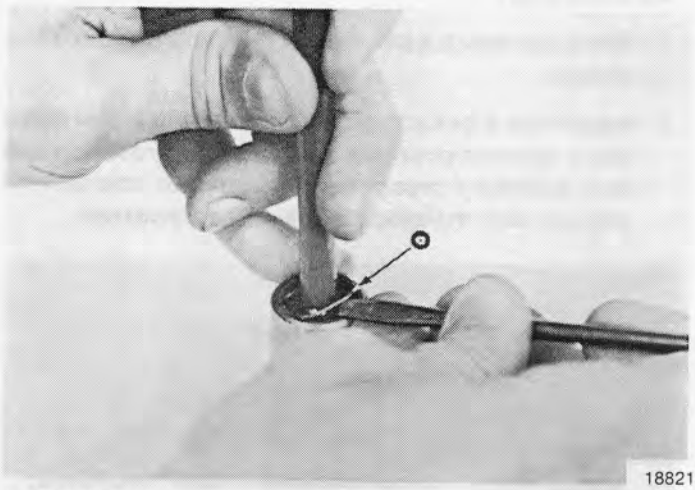
IMPORTANT: Keep push rod and hydraulic valve lifter from each valve together as a matched set and mark them so they can be reinstalled in the same location later.

DISASSEMBLY

IMPORTANT: The internal parts of each hydraulic lifter assembly are matched sets. Do not intermix the parts.

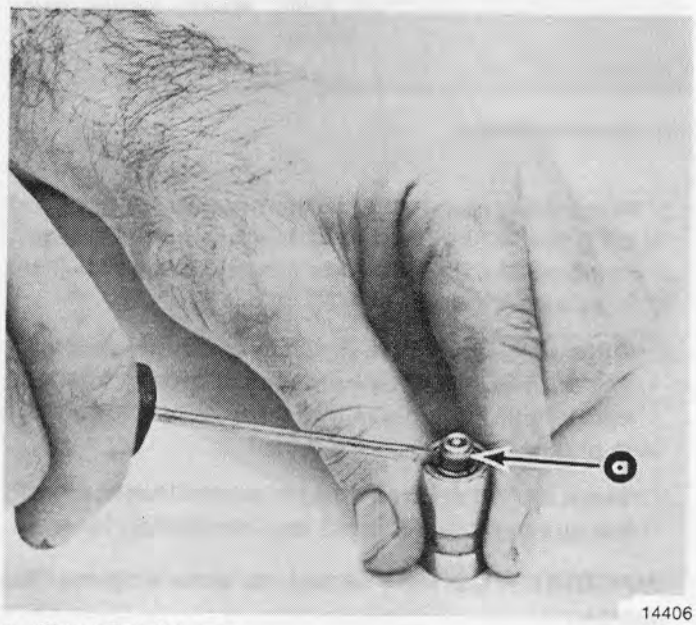
IMPORTANT: Roller lifters must be replaced if the roller tip is worn or damaged. Do not disassemble.

1. Hold plunger down with a push rod and remove push rod seat retainer with the blade of a small screwdriver.
2. Remove push rod seat and metering valve.



a - Seat Retainer

3. Remove the plunger, and the plunger spring.
4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screwdriver.



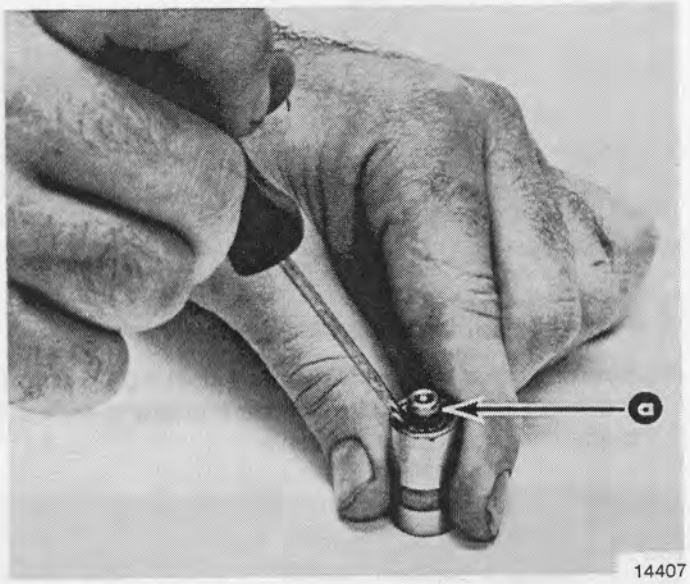
a - Check Ball Retainer

CLEANING and INSPECTION

Thoroughly clean all parts in cleaning solvent and inspect them carefully. If any parts are damaged or worn, entire lifter assembly should be replaced. If outer lifter body wall is scuffed or worn, roller tip tight or worn, inspect cylinder block lifter bore. If bottom of lifter is scuffed or worn, inspect camshaft lobe. If push rod seat is scuffed or worn, inspect push rod.

REASSEMBLY

1. Place the check ball in small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screwdriver.



14407

a - Check Ball Retainer

3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed hole in the lifter body and plunger.
4. Fill the assembly with oil, then insert the end of a 1/8" drift pin into the plunger and press down on check ball until hole in lifter body aligns with hole in plunger.
5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension.

IMPORTANT: DO NOT attempt to force or pump the plunger.

6. Remove the 1/8" drift pin and refill assembly with oil.

14408

7. Install the metering valve, push rod seat and push rod seat retainer.
8. Press down on the push rod seat with a push rod and remove 1/16" drift pin from lifter.

INSTALLATION

IMPORTANT: Before installing lifters/rollers, coat the bottom of the lifter/roller with engine oil. If new lifters or a new camshaft has been installed, an additive containing EP lube (such as Quicksilver Engine Oil Supplement) should be poured over camshaft lobes before installing lifters.

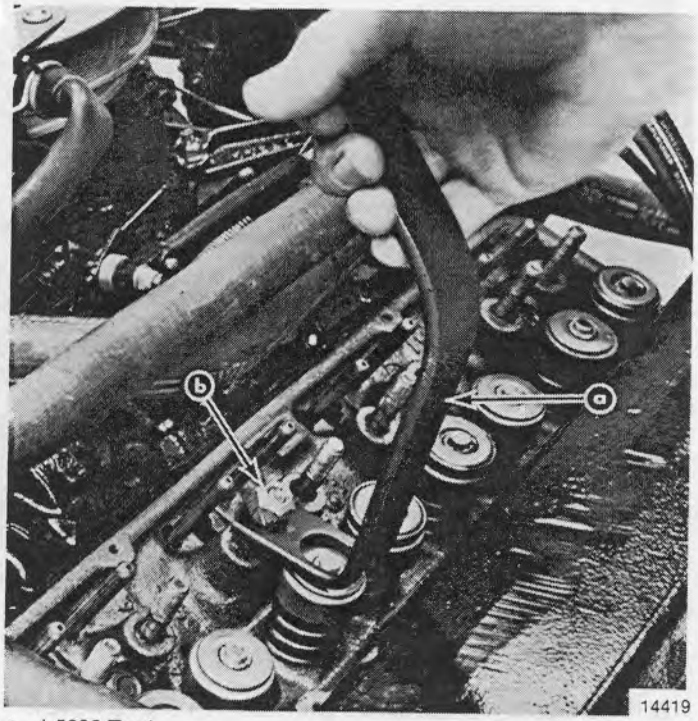
1. Install hydraulic valve lifters, and components.
2. Install intake manifold.
3. Install and adjust valve mechanism as outlined.
4. Install rocker arm cover.
5. Start engine and check for leaks.

Valve Stem Oil Seal Valve Spring

REMOVAL

1. Remove rocker arm cover.
2. Remove spark plug, rocker arm and push rod on cylinder(s) to be serviced.

3. Position piston (in cylinder to be serviced) at TDC, to prevent valve from dropping out of valve guide.
4. Compress valve spring with J-5892 Tool. Remove valve locks and all other components.



a - J-5892 Tool
b - Rocker Arm Nut

INSTALLATION

1. If removed, install damper in valve spring.
2. If engine has additional valve stem seal:
   a. Install intake valve O-ring seal.
   b. DO NOT install exhaust valve O-ring seal, discard.
3. Set valve spring, damper, valve shield and cap in place. Be sure to install valve cap with rotator on exhaust valve. Compress spring with Tool J-5892 and install oil seal into lower groove of valve stem.

IMPORTANT: A light film of oil will help prevent twisting of the seal.

4. Install valve locks and release pressure of tool, being sure that locks are in place. Grease may be used to help hold locks while removing pressure from tool.

Cylinder Head

REMOVAL

1. Drain engine cooling system.
2. Remove exhaust manifolds.
3. Remove intake manifold.
4. Remove valve mechanism.

NOTE: Remove any component attached to front or aft end of cylinder head.

5. Remove spark plugs.
6. Remove spark plug wire retainers from cylinder head.
7. Remove cylinder head bolts, cylinder head and gasket.
8. Place cylinder head on 2 blocks of wood to prevent damage.

CLEANING and INSPECTION

For cleaning and inspection, refer to "Cylinder Head and Valve Conditioning".

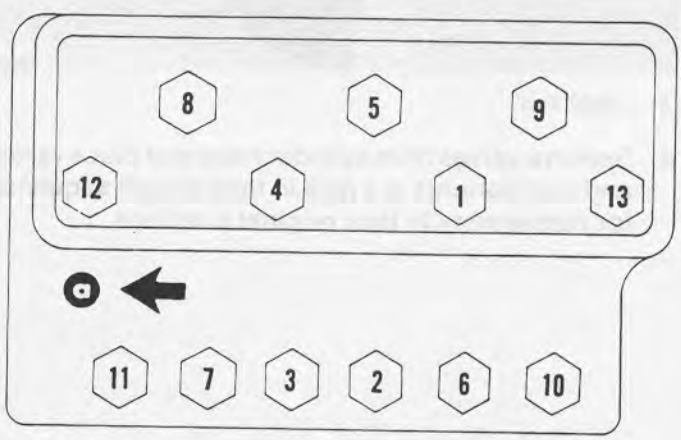
INSTALLATION

⚠CAUTION
Gasket surfaces on both head and block must be clean of any foreign matter and free of nicks or deep scratches. Cylinder bolt threads in block and threads on cylinder head bolts must be clean. (Dirt will affect bolt torque.)

1. **Do not use coatings or sealants if replacement gasket is of graphite composite.** If replacement gasket is a stainless steel shim-type gasket, apply a **thin** coating of Perfect Seal to both sides of the gasket.

IMPORTANT: Do not use a steel gasket.

2. Place gasket in position over dowel pins.
3. Carefully guide cylinder head into place over dowel pins and gasket.
4. Coat threads of cylinder head bolts with Perfect Seal and install bolts finger tight.
5. Tighten each cylinder head bolt a little at a time in sequence shown. Torque to 75 lb. ft. (100 N·m).



a - Front

6. Install exhaust manifolds as outlined.
7. Install intake manifold as described.
8. Install and adjust valve mechanism as outlined.
9. Install valve covers as outlined.
10. Install spark plugs. Torque to 180 lbs. in. (20.3 N.m).
11. Install spark plug wire retainers.

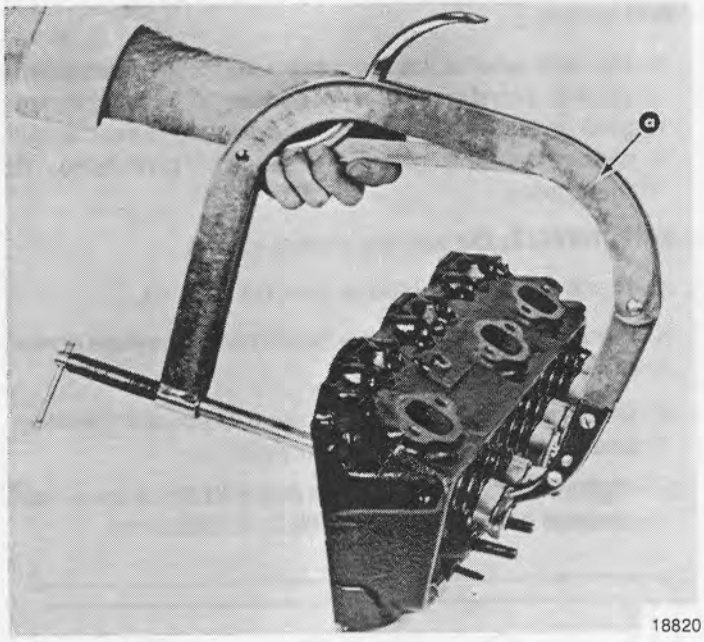
IMPORTANT: Install any component that was removed from the front or aft end of cylinder head.

12. Run engine, adjust timing and check for leaks.

Cylinder Head and Valve Conditioning

DISASSEMBLY

1. With cylinder head removed, remove rocker arms and components (if not previously done).
2. Compress valve springs with J-8062 tool and remove valve retainers. Release compressor tool and remove all valve components.

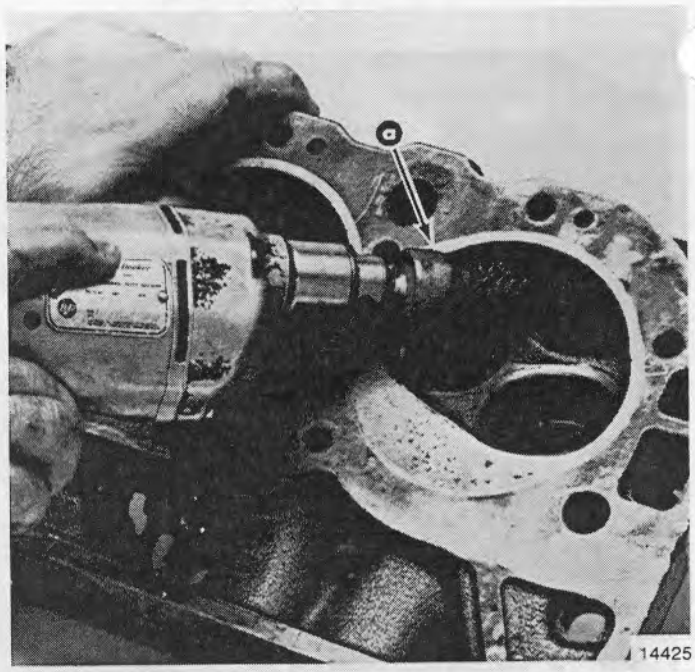


a - J-8062 Tool

3. Remove valves from cylinder head and place valves and components in a rack in their proper sequence for reassembly in their original positions.

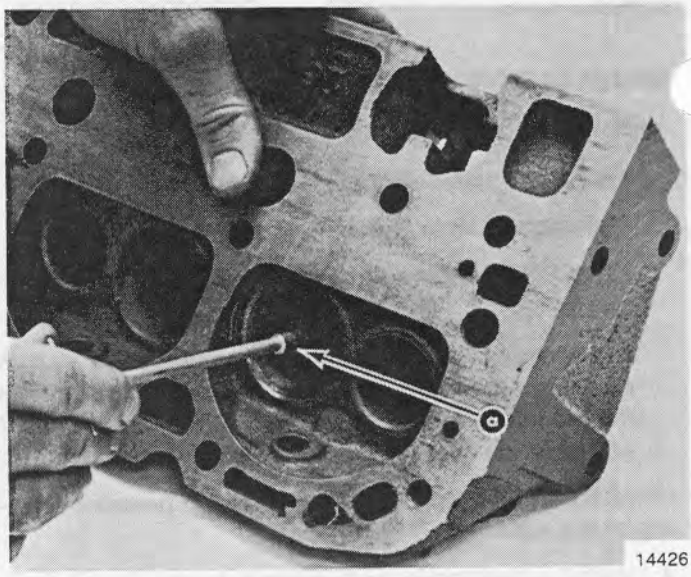
CLEANING

1. Clean all carbon from combustion chambers and valve ports with J-8089 tool.



a - J-8089 Tool

2. Thoroughly clean valve guides with J-8101 tool.

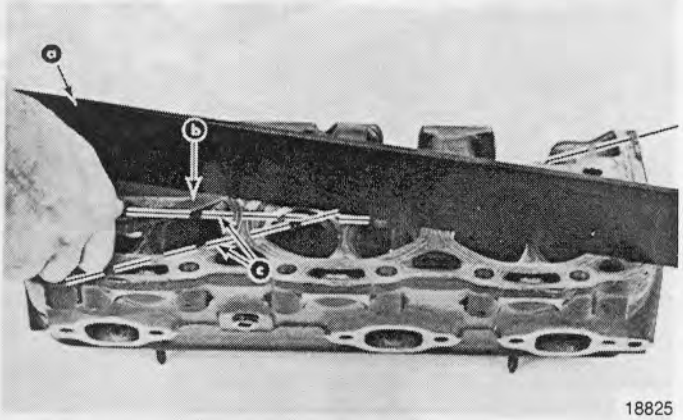


a - J-8101 Tool

3. Clean all push rods, rocker arms and push rod guides.
4. Clean carbon from valves on a buffing wheel.
5. Clean carbon deposits and gasket material from cylinder head mating surfaces.

INSPECTION

1. Inspect cylinder head for cracks in the exhaust ports, combustion chambers (especially around spark plug holes and valve seats) and for cracks in external surface of water jacket. Replace head if cracked.
2. Inspect cylinder head gasket surface for burrs, nicks, erosion or other damage. Also, check flatness of cylinder head gasket surface, using a machinists straight edge and feeler gauges as shown. Refer to "Specifications".



18825

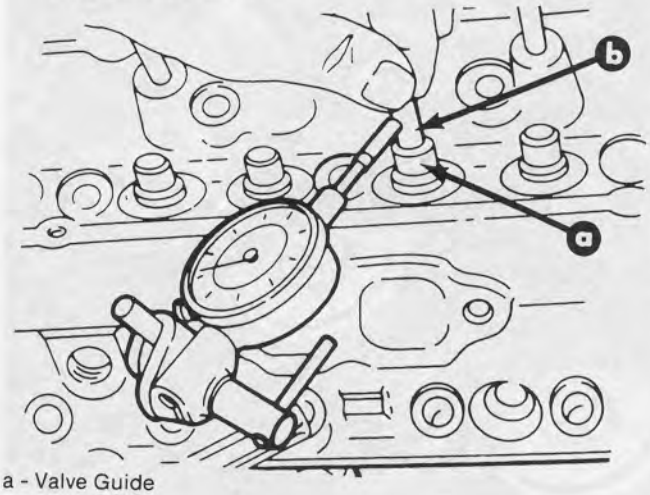
a - Straight Edge
b - Feeler Gauge
c - Take Measurements Diagonally Across Head (Both Ways) and Straight Down Center Head

IMPORTANT: Cylinder head to block gasket surface should be resurfaced if out-of-flat more than specified. When resurfacing gasket surface, cylinder head to intake manifold gasket surface also must be milled to provide proper alignment between manifold and head.

3. Inspect valves for burned heads, cracked faces or damaged stems.

IMPORTANT: Excessive valve stem to bore clearance will cause excessive oil consumption and possible valve breakage. Insufficient clearance will result in noisy and sticky functioning of valve and disturb engine smoothness.

4. Measure valve stem clearance as follows: Clamp a dial indicator on one side of cylinder head rocker arm cover gasket rail, locating indicator so that movement of valve stem from side-to-side (crosswise to the head) will cause a direct movement of indicator stem. Indicator stem must contact side of valve stem just above valve guide. With valve head dropped about 1/16" (2mm) off valve seat, move valve stem from side-to-side, using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves, as outlined under "Valve Guide Bore Repair".



a - Valve Guide
b - Valve Stem

5. Check valve spring tension with J-8056 spring tester.

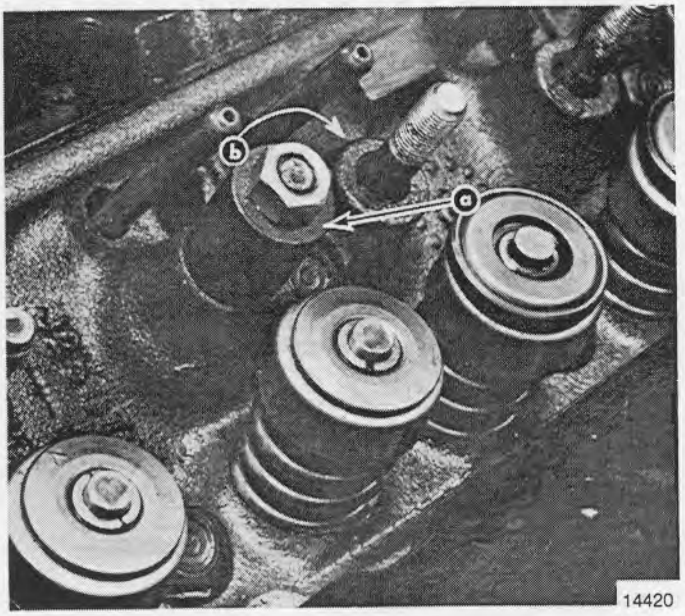
14429

IMPORTANT: Springs should be compressed to specified height and checked against specification. Springs should be replaced if not within 10 lbs. ft. (13.5 N.m) of specified load.

6. Inspect rocker arm studs for wear or damage. Inspect push rod guides for wear or damage.

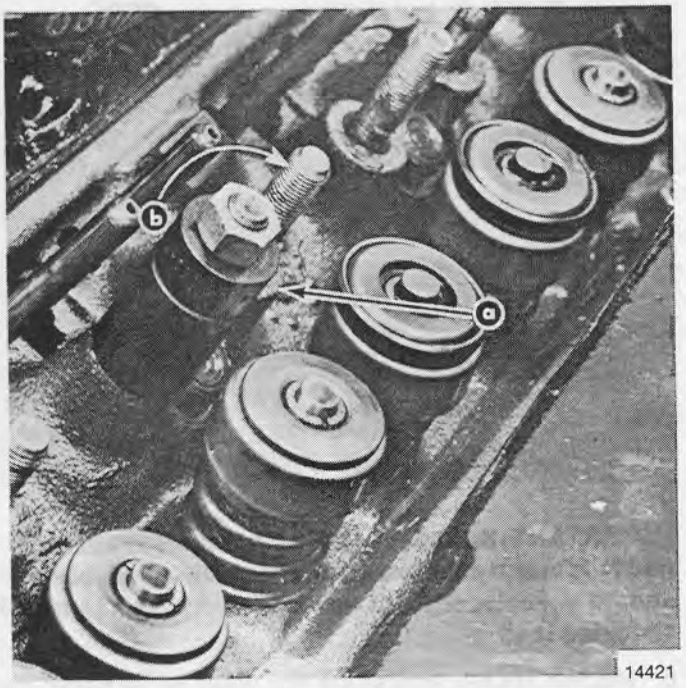
ROCKER ARM STUDS and PUSH ROD GUIDE REPAIRS

1. Rocker arm studs, which are replaced because of wear or looseness, should be replaced with oversize studs.
2. a. Use Tool J-5802-01 to remove old stud by placing flat washer and nut over stud, then turning nut.



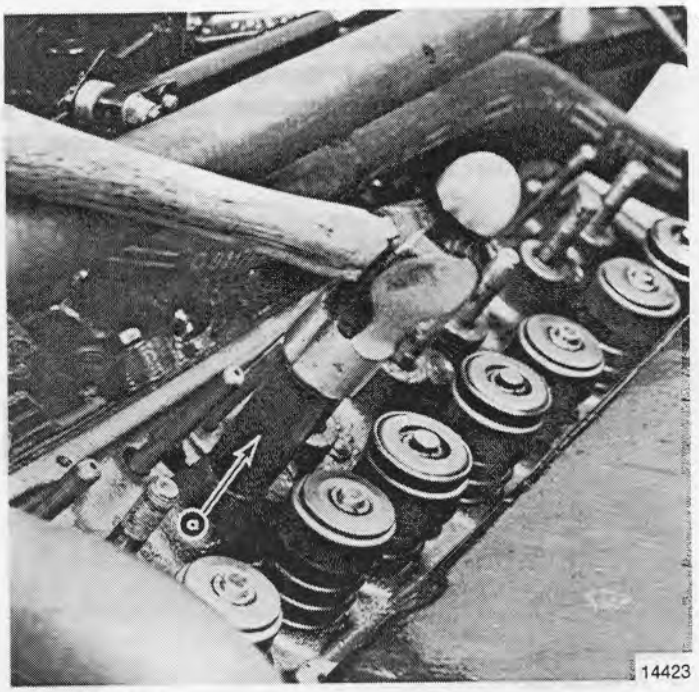
a - Large Sleeve
b - 3/8 x 24 Nut - Turn until Nut Bottoms Out on Stud Threads, Then Remove Nut

b. Remove nut and washer and install second short spacer, washer and nut. Retighten nut until stud is removed.



a - Install Small Sleeve
b - Turn Nut to Remove Stud

3. Ream stud hole, whenever installing an oversize stud, using appropriate reaming tool.
4. Install new stud with Tool J-6880 or similar stud installing tool made for press-in type studs. Follow instructions with tool.



a - J-6880 Tool

VALVE GUIDE BORE REPAIR

IMPORTANT: Be sure to measure valve stem diameter of both the intake and exhaust valve, as valve stem diameter may or may not be the same for both valves.

If .015" oversize valves are required ream valve guide bores for oversize valves, as follows:

1. Measure valve stem diameter of old valve being replaced and select proper size Valve Guide Reamer from chart below.

Standard Valve Stem Diameter	Reamer Required for Oversize Valve
.341	J-5830-2
.372	J-7049-5

2. Ream valve guide bores, as shown.
3. Remove the sharp corner created by reamer at top of valve guide.

18826

VALVE SEAT REPAIR

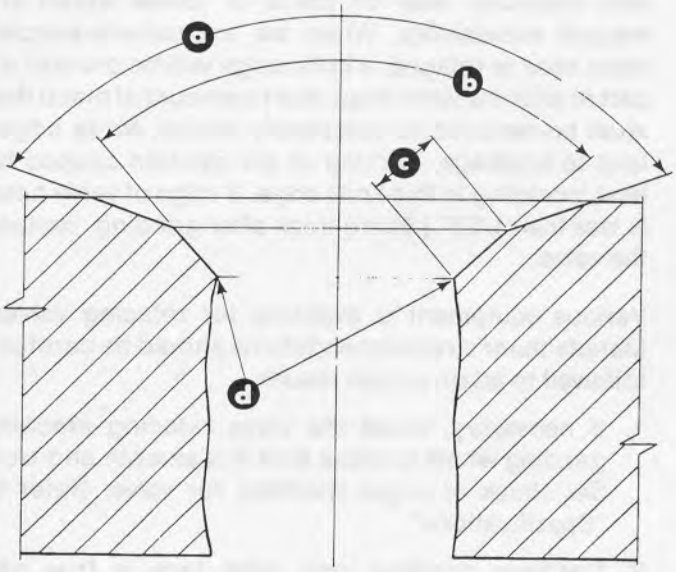
Valve seat reconditioning is very important, since seating of valves must be perfect for engine to deliver maximum power and performance.

Another important factor is valve head cooling. Good contact between each valve and its seat in head is important to insure that heat in valve head will be properly dispersed.

Several different types of equipment are available for reseating valve seats. Equipment manufacturer's recommendations should be followed carefully to attain proper results.

Regardless of type of equipment, however, it is essential that valve guide bores be free from carbon or dirt to insure proper centering of pilot in valve guide.

1. Install expanding pilot in valve guide bore and expand pilot.
2. Place roughing stone or forming stone over pilot and clean up valve seat only. Use a stone that is cut to specifications.
3. Remove roughing stone or forming stone from pilot, place finishing stone (cut to specifications) over pilot and cut just enough metal from seat to provide a smooth finish. Refer to "Specifications".
4. Narrow down valve seats to specified width by grinding with a 30° stone to lower seat and a 60° stone to raise seat.



INTAKE/EXHAUST

a - Top Edge "Approach Angle" (30°)
b - Seat Angle
c - Seat Width
d - Bottom Edge (60°)

5. Remove expanding pilot and clean cylinder head carefully to remove all chips and grinding from above operations.
6. Measure valve seat width. See "Specifications".
7. Measure valve seat "out-of-round". See "Specifications".

05024

VALVE REPAIR

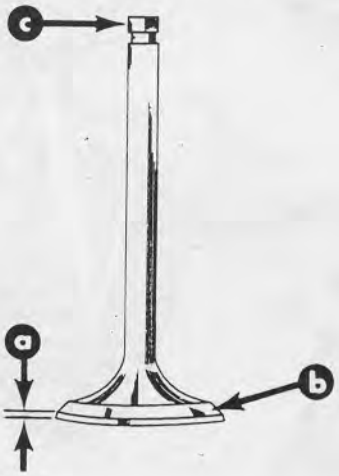
Pitted valves can be refaced to proper angle on a valve grinder, thus insuring correct relation between cylinder head seat and valve mating surface. Replace valves with excessive wear on stems or valves which are warped excessively. When an excessively-warped valve head is refaced, a knife edge will be ground on part or all of the valve head, due to amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition caused by heat localizing in this knife edge. If edge of valve head is less than 1/32" (.8mm) thick after grinding, replace the valve.

Various equipment is available for refacing valves. Manufacturer's recommendations should be carefully followed to attain proper results.

1. If necessary, dress the valve refacing machine grinding wheel to make sure it is smooth and true. Set chuck at angle specified for valve. Refer to "Specifications".
2. Continue grinding until valve face is true and smooth all around the valve. If this makes valve head thin [1/32" (.8mm) minimum], valve must be replaced, or valve will overheat and burn.
3. Remove valve from chuck and place stem in "V" block. Feed valve squarely against grinding wheel to grind any pit from rocker arm end of stem.

IMPORTANT: Only extreme end of valve stem is hardened to resist wear. Do not grind end of stem excessively.

4. After cleaning valve face and cylinder head valve seat of grinding particles, make pencil marks about 1/4" (6mm) across the valve face, place valve in cylinder head and give valve 1/2-turn in each direction while exerting firm pressure on head of valve.
5. Remove valve and check face carefully. If all pencil marks have not been removed at point of contact with valve seat, repeat refacing operation and again recheck for proper seating.



a - 1/32" Minimum
b - Valve Face
c - Stem End

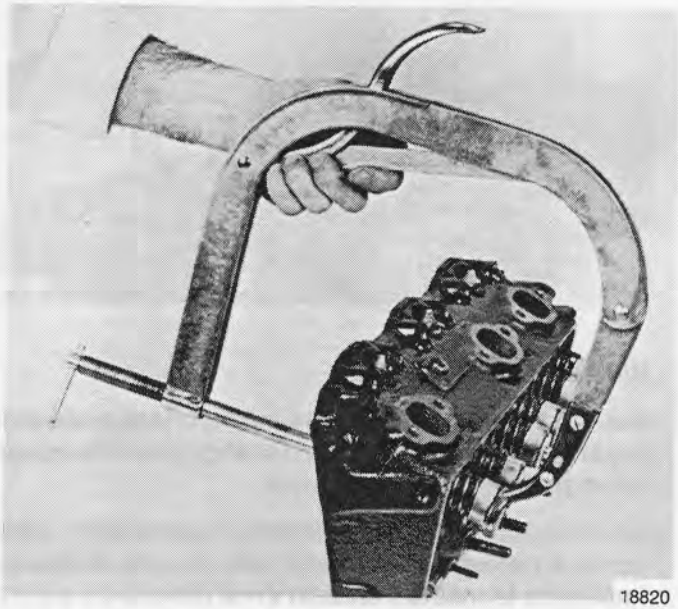
REASSEMBLY

Lubricate valve guides and valve stems with engine oil.

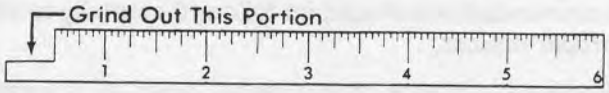
Install each valve in the port from which it was removed or to which it was fitted.

Install valve stem oil seal, valve spring(s) and related parts on each valve as explained under "Valve Stem Oil Seal and/or Valve Spring".

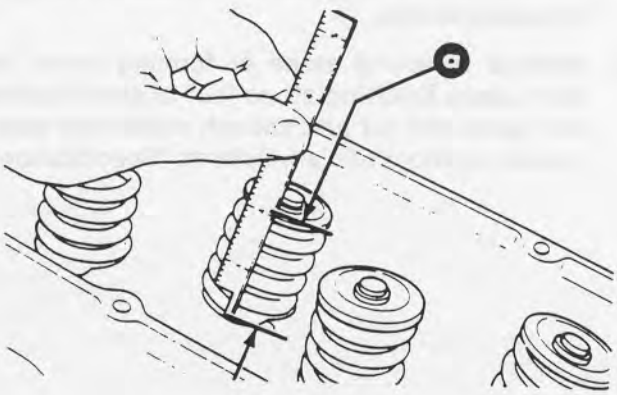
Compress valve spring with Tool J-8062.



Check installed height of the valve springs with a narrow, thin scale. A cutaway scale will help.



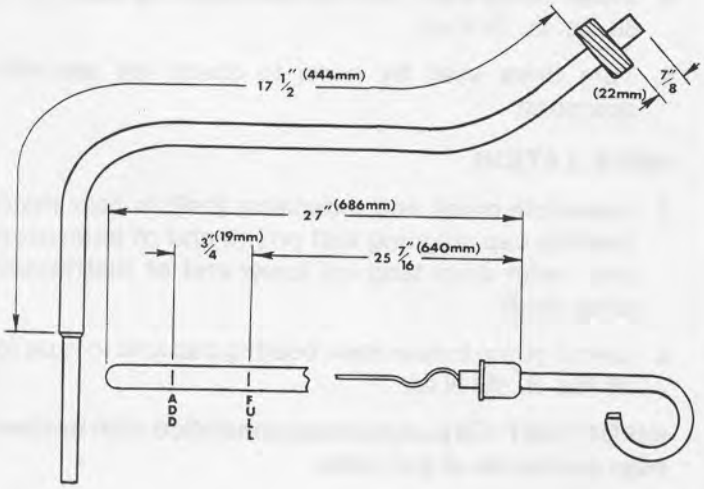
Measure from top of spacer (spring seat) to top of valve spring. If this exceeds specified height, install a valve spring seat shim approximately 1/16" (1.6mm) thick. At no time should spring be shimmed to give an installed height under minimum specified.



Oil Pan

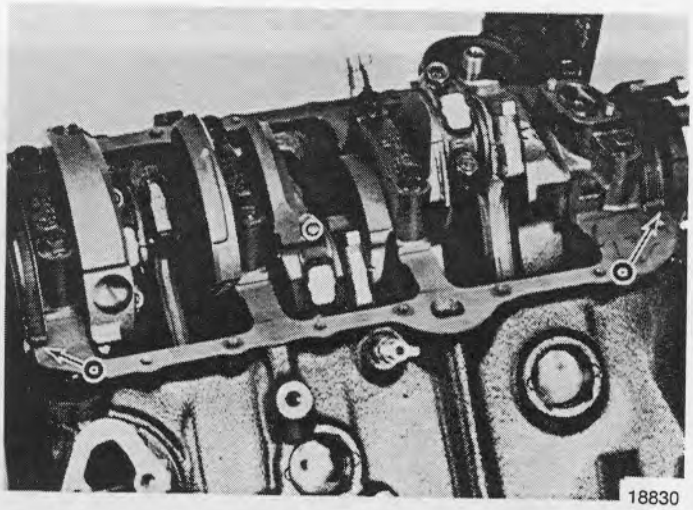
REMOVAL

1. Drain coolant.
2. Drain crankcase oil.
3. Remove oil dipstick and tube, if required.
4. Remove oil pan and discard gaskets.



INSTALLATION

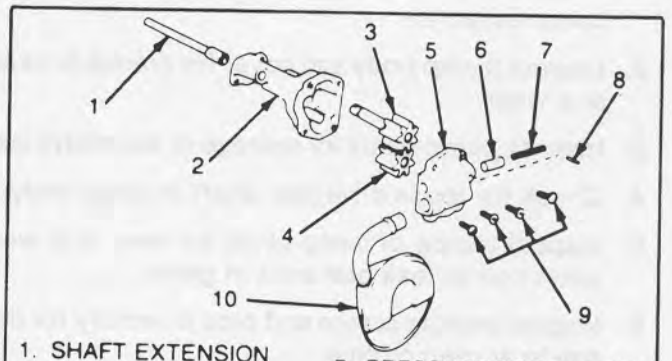
1. Thoroughly clean gasket and seal surfaces on oil pan, cylinder block, rear main bearing cap and crankcase front cover.
2. Coat both sides of oil pan side gaskets with Perfect Seal and place gaskets in position on each side of cylinder block.
3. Apply a 1/8" (3mm) bead of RTV Sealer to front and rear seal mating surfaces on cylinder block rear main bearing cap, front cover and gaskets.



IMPORTANT: RTV Sealer sets up in about 15 minutes. Be sure to complete assembly promptly.

4. Install new front and rear seals, being sure ends of seals are butted properly against side gaskets.

Oil Pump



1. SHAFT EXTENSION
2. PUMP BODY
3. DRIVE GEAR AND SHAFT
4. IDLER GEAR
5. PUMP COVER
6. PRESSURE REGULATOR VALVE
7. PRESSURE REGULATOR SPRING
8. RETAINING PIN
9. SCREWS
10. PICKUP SCREEN AND PIPE

The oil pump consists of 2 gears and a pressure regulator valve enclosed in a 2-piece housing. Oil pump is driven by distributor shaft which is driven by a helical gear on camshaft.

A baffle is incorporated on pickup screen to eliminate pressure loss and engine oil pump tubes are bent at special angles.

REMOVAL

1. Remove oil pan.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

DISASSEMBLY

1. Remove pump cover attaching screws and pump cover.

IMPORTANT: Mark gear teeth for reassembly with same teeth indexing.

2. Remove idler gear, drive gear and shaft from pump body.
3. Remove retaining pin, pressure regulator valve and related parts.

IMPORTANT: Do not remove pickup screen and pipe assembly, unless replacement is necessary. Loss of press fit condition could result in an air leak and loss of oil pressure.

IMPORTANT: Do not disturb pickup screen on pipe. This is serviced as an assembly.

4. If pickup screen and pipe assembly requires replacement, mount pump in a soft jawed vise and extract pipe from pump.

CLEANING and INSPECTION

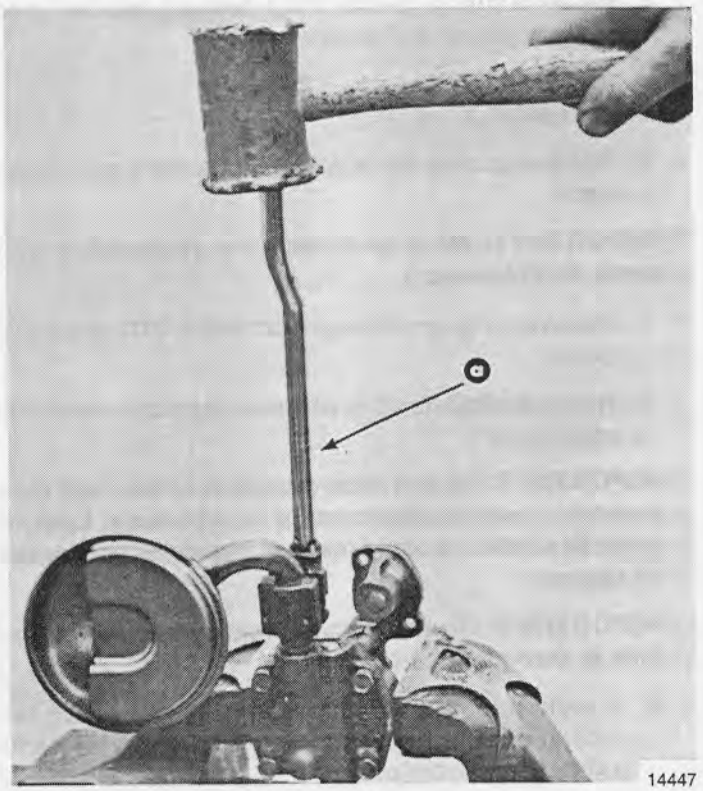
1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
4. Check for loose drive gear shaft in pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past ends of gears.
6. Inspect pickup screen and pipe assembly for damage to screen or pipe.
7. Check pressure regulator valve for fit.

IMPORTANT: Pump gears and body are not serviced separately. If pump gears or body are damaged or worn, replacement of entire oil pump assembly is necessary.

REASSEMBLY

⚠CAUTION
Be careful of twisting, shearing or collapsing pipe while installing in pump. Pickup screen must be parallel to oil pan rails when oil pump is installed.

If pickup screen and pipe assembly was removed, mount pump in a soft-jawed vise, apply Perfect Seal to end of new pipe and using Tool (J-8369), tap the pipe in place with a hammer.



a - J-8369 Tool

IMPORTANT: Oil internal parts liberally before installation.

1. Install pressure regulator valve and related parts.
2. Install drive gear and shaft in pump body.
3. Install idler gear in pump body with smooth side of gear toward pump cover opening. Align marks made in disassembly.
4. Install pump cover and torque attaching screws to 80 lbs. in. (9 N.m).
5. Turn drive shaft by hand to check for smooth operation.

INSTALLATION

1. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.
2. Install pump to rear main bearing cap and torque to 65 lbs. ft. (88 N.m).

IMPORTANT: Oil pump screen is installed with bottom edge parallel to oil pan rails.

3. Install oil pan as outlined.

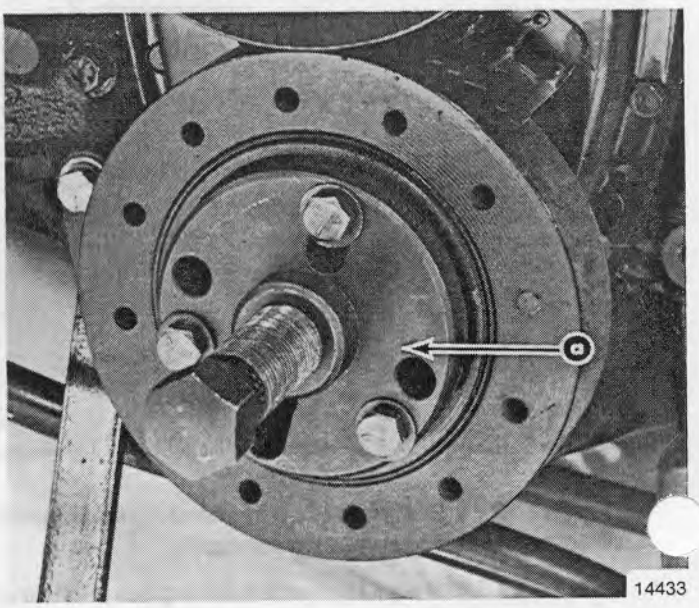
Torsional Damper

REMOVAL

1. Remove drive belts.
2. Remove drive pulley, then remove damper retaining bolt.

IMPORTANT: Do not use a universal claw type puller to remove torsional damper (in next step) as outside ring of damper is bonded in rubber to the hub and use of claw type puller may break the bond.

3. Remove damper with Tool J-23523-03.



a - J-23523-03 Tool

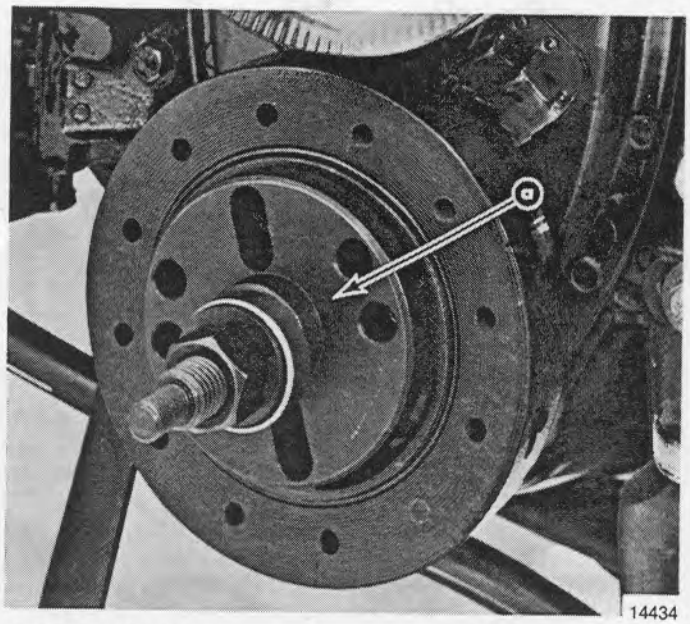
INSTALLATION

IMPORTANT: The inertia weight section of torsional damper is assembled to the hub with a rubber type material. The installation procedure (with proper tool) must be followed or movement of the inertia weight on the hub will destroy the tuning of the torsional damper.

1. Coat front cover seal contact area (on damper) with engine oil.
2. Pull damper onto crankshaft, using Tool J-23523-03, as follows:
   a. Install appropriate end of threaded rod into crankshaft.

IMPORTANT: Be sure to install threaded rod in crankshaft so that at least 1/2" (13mm) of thread engagement is obtained to prevent damage to threads.

   b. Install plate, thrust bearing, washer and nut on rod.
   c. Pull damper onto crankshaft (by turning nut) until it bottoms-out.



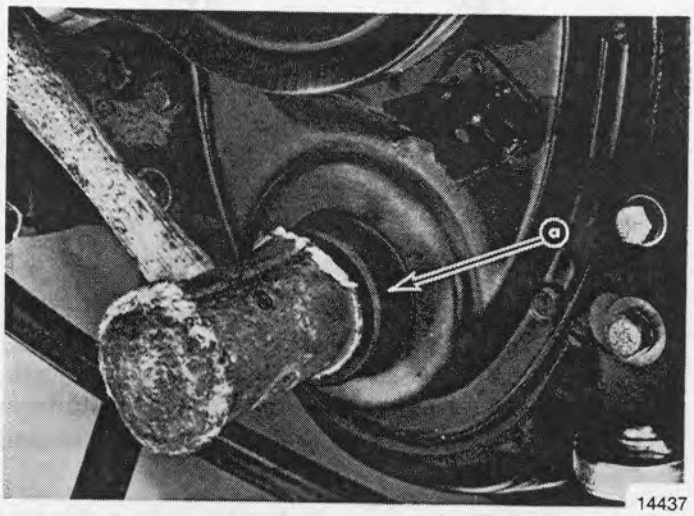
a - J-23523-03 Tool

   d. Remove tool from crankshaft, then, install damper retaining bolt and torque to 60 lb. ft. (81 N.m).
3. Install drive pulley(s).
4. Install and adjust drive belts.

Crankcase Front Cover Oil Seal

OIL SEAL REPLACEMENT (Without Removing Front Cover)

1. Remove torsional damper.
2. Pry seal out of cover from the front with a large screwdriver, being careful not to distort front cover or damage crankshaft seal surface.
3. Install new seal with open end of seal inward, using Tool J-23042. Drive seal in until it just bottoms out. Do not use excessive force.
4. Reinstall torsional damper.



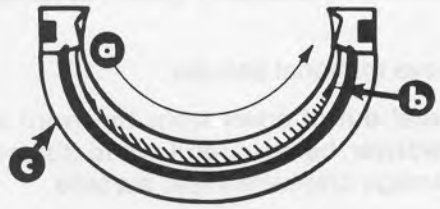
a - J-23042 Tool

REMOVAL

1. Remove engine from boat.
2. Remove torsional damper and oil pan.
3. Remove water circulating pump.
4. Remove crankcase front cover attaching screws and remove cover. Remove and discard cover gasket.
5. If damaged, drive oil seal out of front cover (from the rear) with a punch.

INSTALLATION

IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.



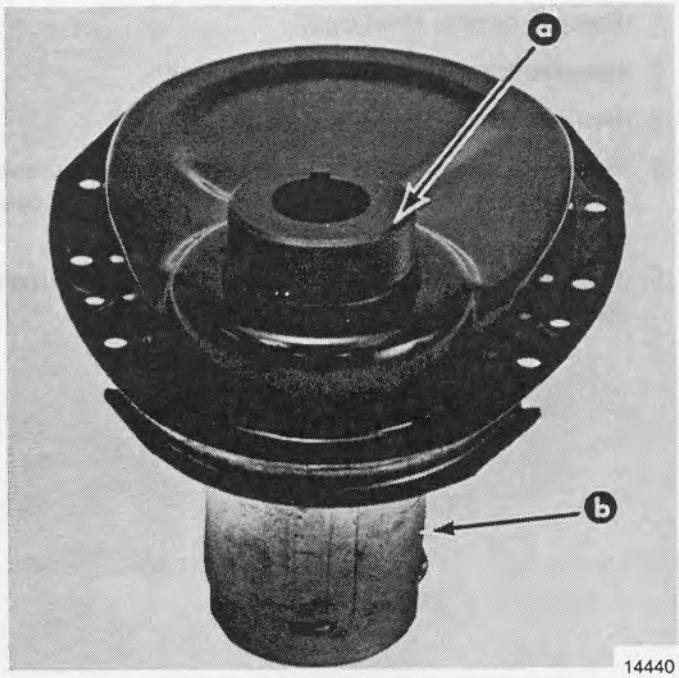
533-H

a - Engine Rotation (Viewed-Rear to Front)
b - Lip Toward Inside of Engine
c - Seal with Helical Grooves

532-H

a - Can Be Used On Any Rotation Engine
b - Seal Lip Toward Inside of Engine

1. Clean front cover in solvent and dry with compressed air. Clean old gasket material and sealer from mating surfaces on cover and cylinder block. Check gasket surface on front cover for distortion and true if necessary. Surfaces must be clean and flat or oil leakage may result.
2. Install oil seal in cover with lip of seal toward inside of engine, using Tool J-23042. Support cover around seal area with appropriate tool as shown.



14440

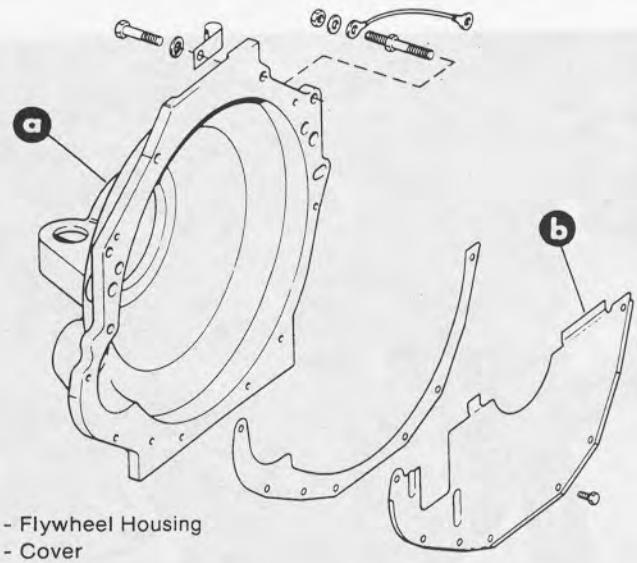
a - J-23042 Tool
b - Support (To Prevent Distorting Cover)

3. Coat both sides of front cover gasket with Perfect Seal and place in position on engine.
4. Install front cover, making sure holes in cover align with dowel pins in block. Torque front cover 80 lb. in. (9 N.m).
5. Install oil pan and torsional damper as outlined.
6. Install water circulating pump. Torque to 30 lb. ft. (40 N.m).
7. Reinstall engine in boat.
8. Fill crankcase with engine oil.
9. Start engine and check for water and oil leaks.

Flywheel

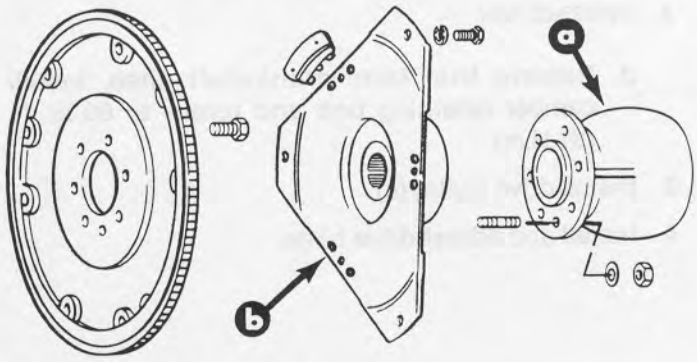
REMOVAL

1. Remove engine from boat.
2. Remove flywheel housing and related parts.



a - Flywheel Housing
b - Cover

3. Remove engine coupler and flywheel.



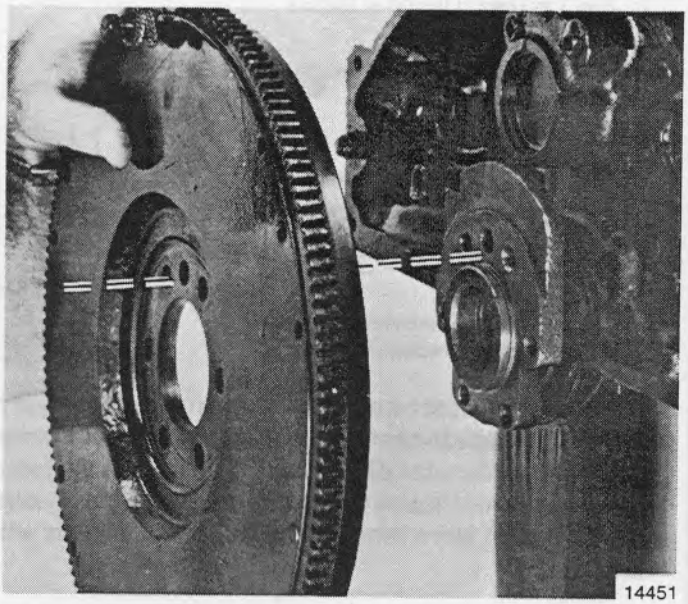
a - Earlier Style (Flywheel Stud Mounted)
b - Later Style

INSPECTION

1. Check flywheel ring gear for worn or missing teeth.
2. Inspect coupler for worn splines or torn rubber.

INSTALLATION

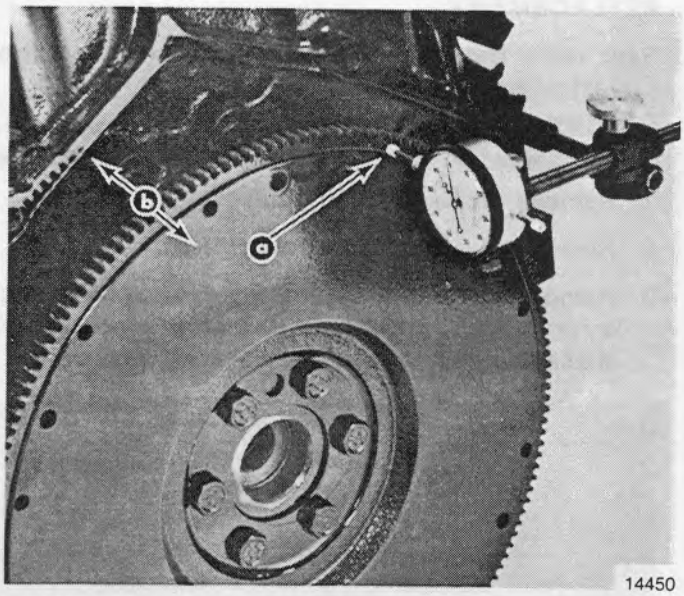
1. Clean mating surfaces of flywheel and crankshaft.
2. If removed, apply Loctite-A to threads of studs and install.
3. Align dowel hole in flywheel with dowel hole in crankshaft flange and install flywheel.



14451

IMPORTANT: Only couplers with large bumpers (later style couplers) are to be used on engines equipped with Fluid Mounts.

4. Install coupler with washers and screws (or locknuts). Torque to 40 lb. ft. (54 N.m).
5. Lubricate coupler splines with 2-4-C Marine Lubricant.
6. Check flywheel runout by mounting dial indicator against machined surface of flywheel.



14450

a - .008 in. (.203mm) Max. Runout
b - Hold Flywheel and Crankshaft Forward or Rearward As Far As It Will Go When Taking Reading

7. Runout should not exceed .008 in. (.203mm) if excessive, remove flywheel and check for burrs or replace flywheel.
8. Install flywheel housing and related parts. Torque bolts to 30 lb. ft. (40.7 N.m).

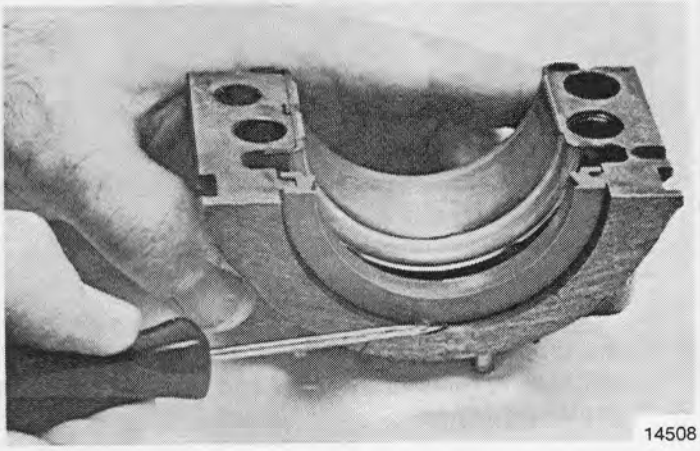
Oil Seal (Early Style Rear Main)

REPLACEMENT

Rear main bearing oil seal can be replaced (both halves) without removing crankshaft.

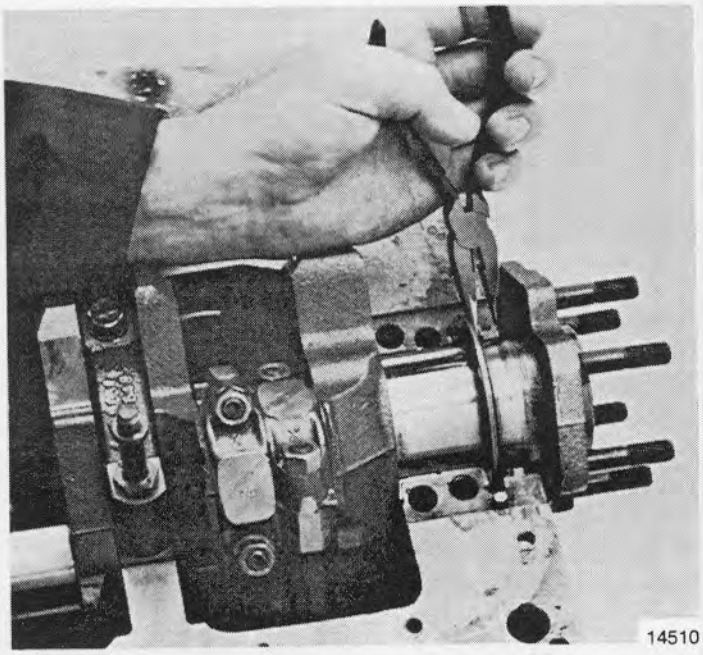
IMPORTANT: Always replace upper and lower seal as a unit. Install with lip facing toward inside of engine.

1. Remove oil pan and oil pump.
2. Remove rear main bearing cap.
3. Remove lower half of oil seal from the bearing cap by prying from the bottom with a small screwdriver. Be careful not to damage seal seating surface.



14508

4. Using a hammer and a soft metal punch, tap upper half of oil seal on one end until it protrudes far enough on the other end to remove it with a pliers.

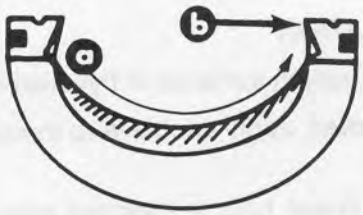


14510

5. Clean, rear main bearing cap, cylinder block and crankshaft with solvent and blow dry with compressed air. Be sure all of the old sealer is removed from bearing cap and cylinder block mating surfaces.

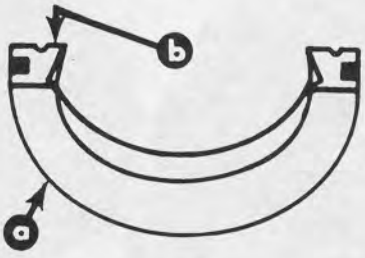
INSTALLATION

IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.



541-H

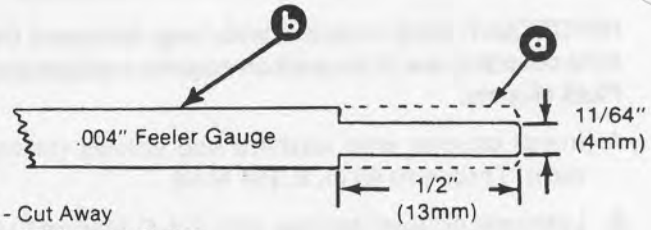
a - Left Hand Rotation (Flywheel End Looking Forward)
b - Seal Lip Toward Inside of Engine



540-H

a - Can Be Used On Any Rotation Engine
b - Seal Lip Toward Inside of Engine

Extreme care must be exercised when installing seal to prevent damage to sealing bead, located in the channel on outside diameter of the seal. To protect this bead, installation tool must be used. Construct tool using .004" (.1mm) shim stock, if tool is not supplied with seal.

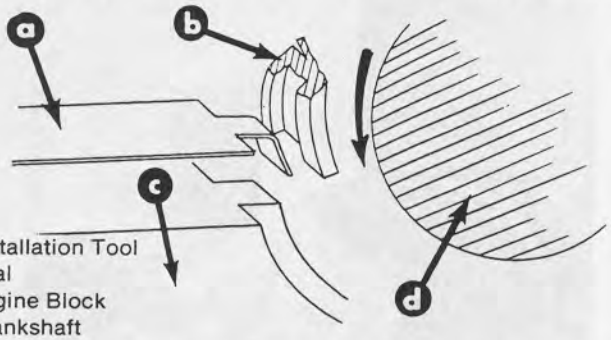


a - Cut Away
b - .004" Feeler Gauge

1. Coat lips and sealing bead on new rear oil seal with engine oil. Keep oil off of seal parting surfaces.

IMPORTANT: Be sure to install oil seal with lip facing toward inside of engine.

2. Install upper half of oil seal:
   a. Position tip of installation tool between crankshaft and seal seating surface in cylinder block.
   b. Position upper half of seal between crankshaft and tip of installation tool so that seal bead contacts tips of tool.
   c. Roll upper half of seal around crankshaft using installation tool as a "shoe-horn" to protect seal bead from sharp corner of seal seating surface.

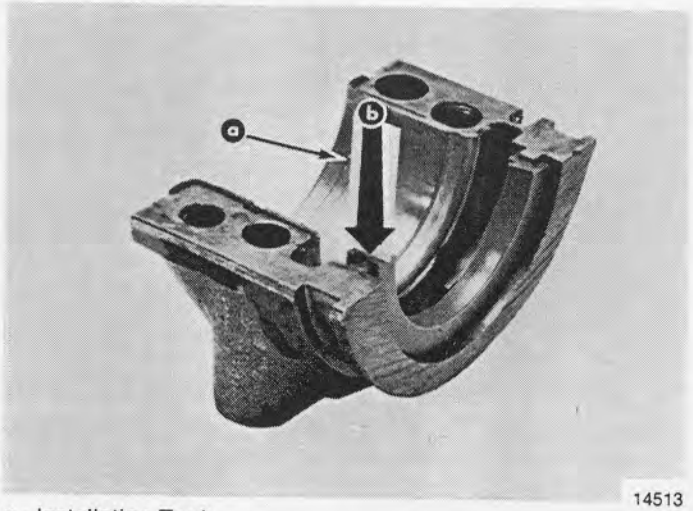


a - Installation Tool
b - Seal
c - Engine Block
d - Crankshaft

IMPORTANT: Installation tool must remain in position until seal is properly positioned with both ends flush with block.

   d. After both ends of seal half are flush with block, remove installation tool.

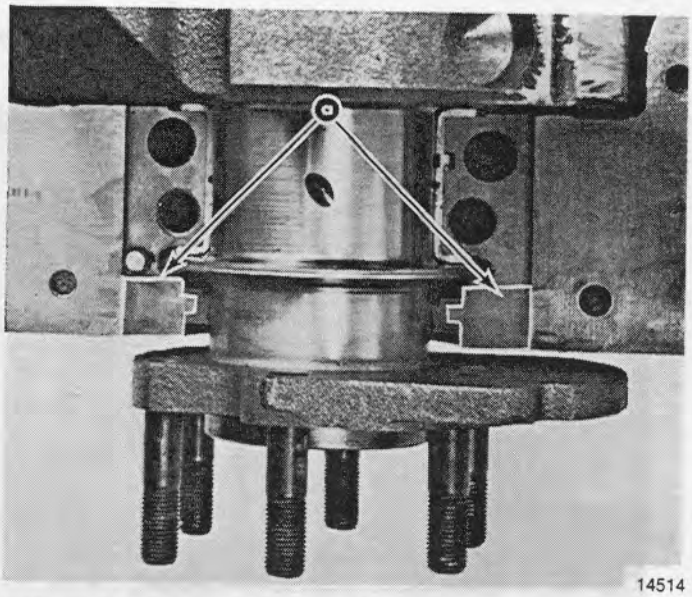
3. Install lower half of oil seal:
   a. Position oil seal half in rear main bearing cap so that one end is slightly below mating surface and seal lip is facing toward bearing. Do not allow sealing bead on other end of seal half to contact seal seating surface.
   b. Insert installation tool in between sealing bead and seal seating surface, then, using tool as a "shoe-horn" to protect sealing bead from sharp corner of seal seating surface, roll seal into place. Seal is properly positioned when both ends are flush with cap.
   c. Remove installation tool.



14513

a - Installation Tool
b - Roll Seal Half Into Position in This Direction

4. Make sure that bearing cap and cylinder block mating surfaces and oil seal parting surfaces are clean and free of oil, then apply Perfect Seal to block at locations shown. Do not get sealer on seal parting surfaces or on surfaces adjacent to main bearing inserts.



14514

a - Apply Perfect Seal to Outlined Area Only

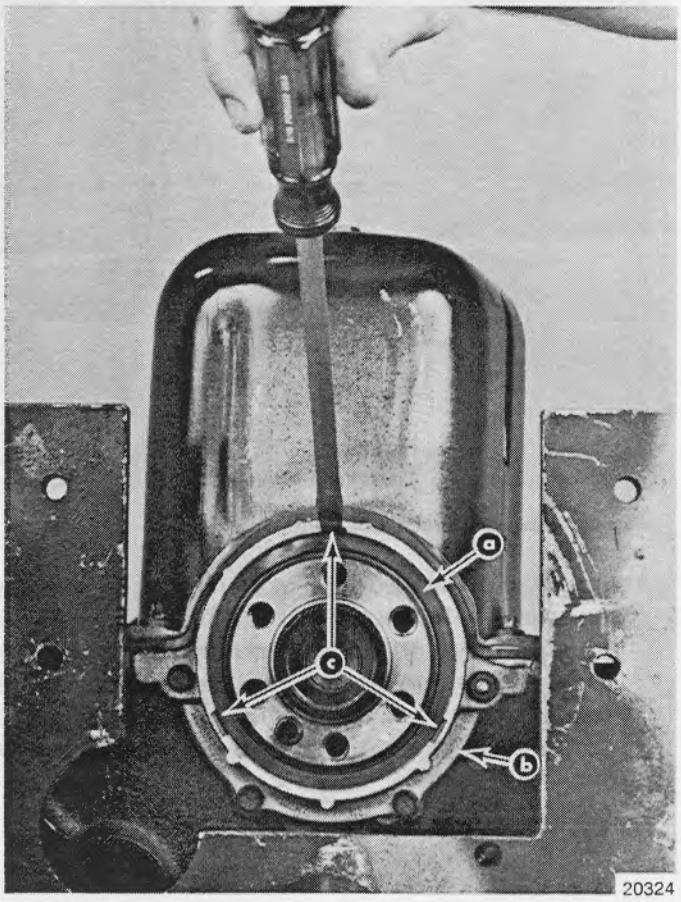
5. Install rear main bearing cap and torque attaching bolts to 10-12 ft. lbs. (13-16 N.m). Tap crankshaft first rearward and then forward with a lead hammer to line up rear main bearing thrust surfaces. With crankshaft in forward position, torque rear main bearing cap attaching bolts evenly (alternating from side to side).
6. Install oil pump and oil pan as outlined.

Oil Seal (New Style Rear)

The new style rear crankshaft oil seal can be replaced without removing the oil pan or rear main bearing cap from engine.

REMOVAL

1. Remove seal by prying out by the three slots located in the seal retainer.



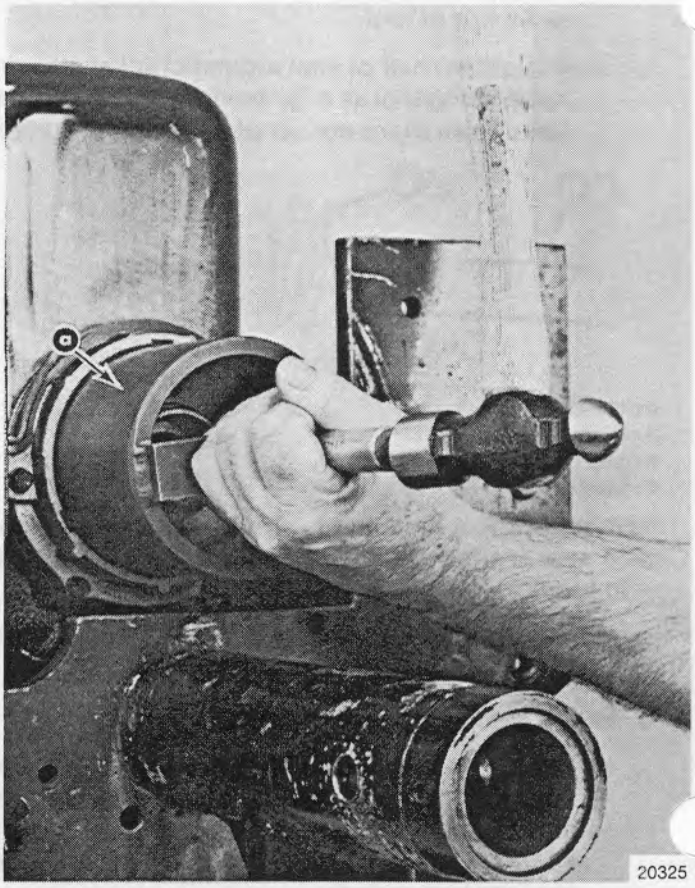
a - Rear Seal
b - Seal Retainer
c - Slots (Three)

Removing Rear Crankshaft Seal

2. Clean crankshaft/seal running surface and seal retainer.

INSTALLATION

1. Apply Perfect Seal to seal retainer mating surface. Apply grease to seal lips.
2. Install seal with Kent Moore Tool J-26817-A.



a - Kent Moore Tool J-26817-A

Installing Seal

Main Bearings

INSPECTION

In general (except No. 1 bearing), lower half of bearing shows a greater wear and most distress from fatigue. After inspection, if lower half is suitable for use, it can be assumed that the upper half also is satisfactory. If lower half is worn or damaged, both upper and lower halves should be replaced. Never replace one half without replacing the other.

CHECKING CLEARANCE

To obtain best results, use Plastigage (or its equivalent), a wax-like plastic material which will compress evenly between bearing and journal surfaces without damaging either surface. With engine upside-down, crankshaft will rest on upper bearings, and total clearance can be measured between lower bearing and journal.

IMPORTANT: To assure proper seating of crankshaft, all bearing cap bolts should be at their specified torque. In addition, surface of crankshaft journal and bearing should be wiped clean of oil before checking fit of bearings. Remove oil seal from rear main bearing cap prior to checking clearance.

1. With oil pan, and oil pump removed (starting with rear main bearing), remove bearing cap and wipe oil from journal and bearing cap.

   Main bearings are precision insert type and do not utilize shims for adjustment. If clearances are excessive, a new bearing (both upper and lower halves) will be required. Bearings are available in standard size and undersize. Selective fitting of both rod and main bearing inserts is necessary in production to obtain close tolerances. Consequently, one half of a standard insert may have one half of a .001" undersize insert which will decrease clearance .0005" from using a full standard bearing.

   When a production crankshaft cannot be precision fitted by this method, it then is ground .009" (.229mm) undersize on main journals only. A .009" undersize bearing and .010" undersize bearing may be used for precision fitting in the same manner as previously described. Any engine fitted with a .009" undersize crankshaft will be identified by the following markings:

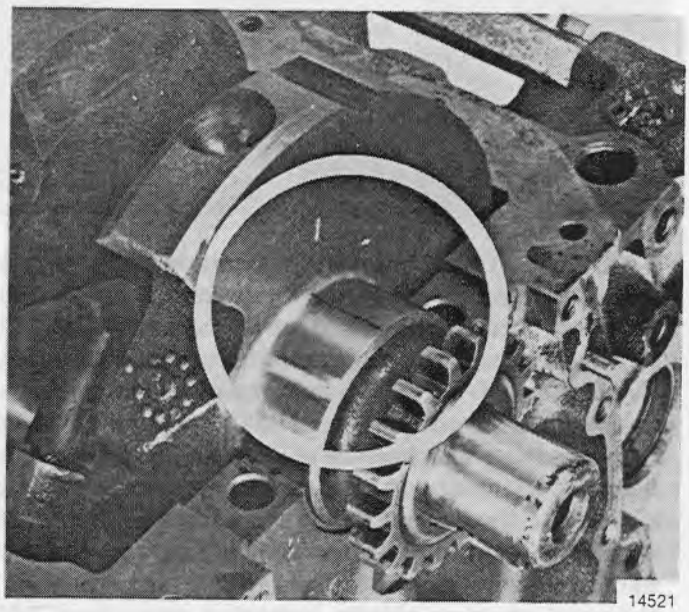
   ".009" will be stamped on crankshaft counterweight forward of center main journal.

   A figure "9" will be stamped on block at left front oil pan rail.

   A crankshaft with an undersize journal will be painted with light green on each side of the affected journal.

IMPORTANT: If crankshaft has an undersize journal and a new bearing is required, journal must be reconditioned to accept a .010" or a .020" undersize bearing as .009" undersize bearings are not available for service.

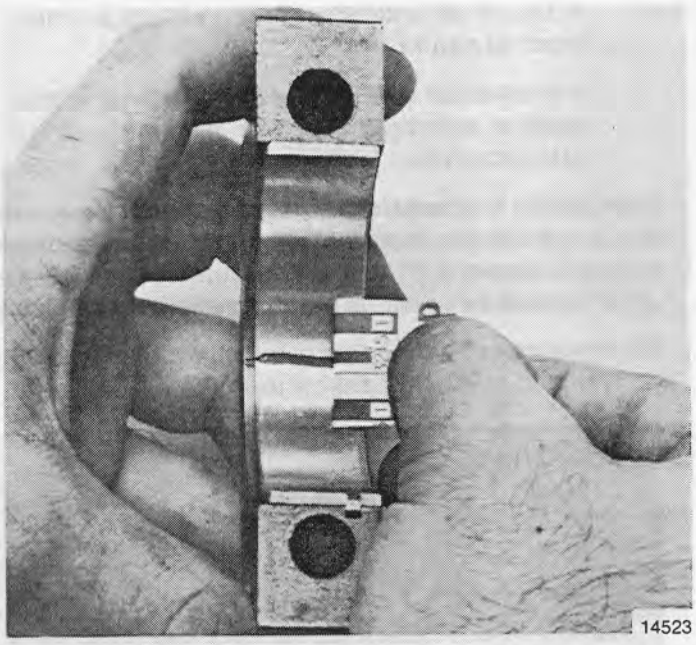
2. Place a piece of gauging plastic full width of bearing (parallel to crankshaft) on journal.


14521

IMPORTANT: Do not rotate crankshaft while gauging plastic is between bearing and journal.

3. Install bearing cap and torque retaining bolts evenly to specifications.
4. Remove bearing cap. Flattened gauging plastic will be found adhering to either bearing shell or journal.

5. Use graduated scale (correlated in thousandths of an inch) on edge of gauging plastic envelope. Without removing gauging plastic, measure its compressed width (at widest point) with graduations on gauging plastic envelope.

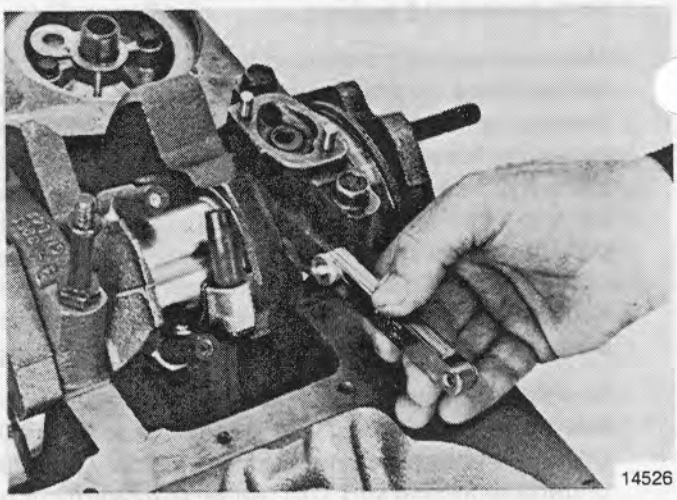

14523

IMPORTANT: Main bearing journals usually wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal [.001" (0.25mm) maximum], be sure to fit to maximum diameter of journal. If bearing is fitted to minimum diameter, and journal is out-of-round .001", interference between bearing and journal will result in rapid bearing failure. If flattened gauging plastic tapers toward middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of bearing or journal. Be sure to measure journal with a micrometer if flattened gauging plastic indicates more than .001" difference.

6. If bearing clearance is within specifications, bearing insert is satisfactory. If clearance is not within specifications, replace the insert. Always replace both upper and lower insert as a unit.

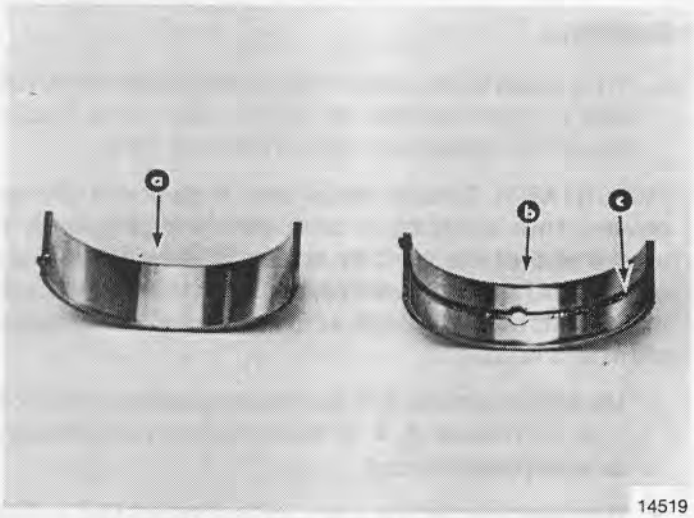
IMPORTANT: If a new bearing cap is being installed and clearance is less than .001", inspect for burrs or nicks.

7. A standard .001" or .002" undersize bearing may produce proper clearance. If not, regrind crankshaft journal for use with next undersize bearing.
8. Proceed to next bearing. After all bearings have been checked, rotate crankshaft to see that excessive drag does not exist.
9. Install front 3 main bearing caps and torque evenly to 85 lbs. ft. (115 N.m).
10. Install rear main bearing cap and torque attaching bolts to 10-12 ft. lbs. (13-16 N.m). Tap end of crankshaft first rearward and then forward with a hammer to align rear main bearing thrust surfaces. With crankshaft in forward position, torque rear main bearing attaching bolts evenly (alternating from side to side) to 85 lbs. ft. (115 N.m).
11. Measure crankshaft end play with a feeler gauge by forcing crankshaft forward and measuring clearance between the front of the rear main bearing and the crankshaft. If clearance is excessive rear main bearing and/or crankshaft must be replaced.
12. Install a new rear main bearing oil seal in cylinder block and main bearing cap, as outlined.


14526

REPLACEMENT

IMPORTANT: Main bearings may be replaced with or without removing crankshaft.



14519

a - Lower Bearing Insert (Install in Cap)
b - Upper Bearing Insert (Install in Block)
c - Oil Groove

With Crankshaft Removed:

1. Remove and inspect crankshaft.
2. Remove main bearings from cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in cylinder block and main bearing caps.
4. Install crankshaft.

Without Crankshaft Removed:

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Replace main bearing upper half as follows:
   a. Install main bearing removing and installing tool J-8080 in crankshaft journal oil hole.

IMPORTANT: If tool is not available, bend a cotter pin.

   b. Rotate crankshaft clockwise (as viewed from front of engine). This will roll upper bearing out of block.
   c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and notched side of block. Rotate bearing into place and remove tool from oil hole in crankshaft journal.
3. Oil new lower bearing and install in bearing cap.
4. Install main bearing cap with arrows pointing toward front of engine.
5. Torque main bearing cap bolts to 85 lbs. ft. (115 N.m).

Connecting Rod Bearings

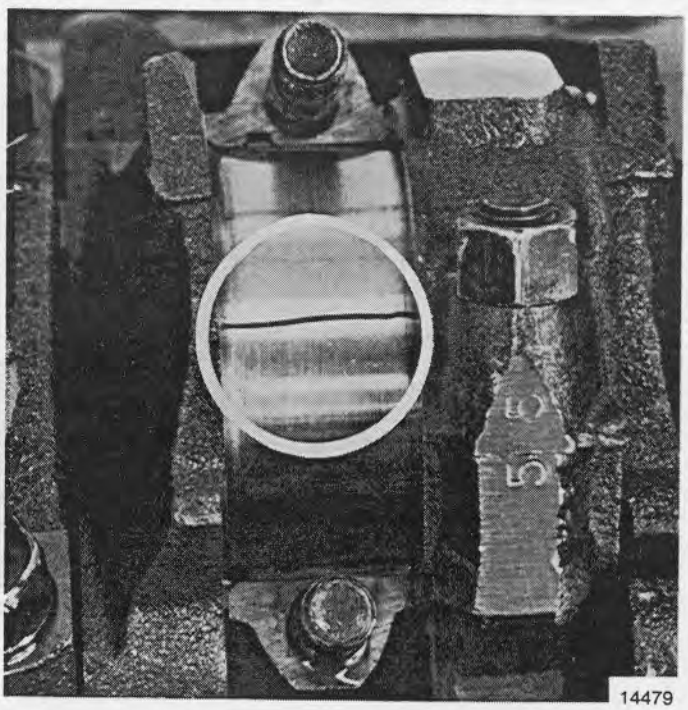
Connecting rod bearings are precision insert type and do not utilize shims for adjustment. Do not file rods or rod caps. If clearances are found to be excessive, a new bearing will be required. Bearings are available in standard size and undersize for new and used standard size crankshafts and reconditioned crankshafts.

INSPECTION and REPLACEMENT

1. With oil pan and oil pump removed, remove connecting rod cap and bearing.
2. Inspect bearing for wear or damage and replace unsatisfactory bearings.
3. Wipe bearings and crankpin clean of oil.
4. Measure crankpin for out-of-round or taper with a micrometer. If not within specifications, replace or recondition crankshaft. If within specifications, and a new bearing is to be installed, measure maximum diameter of crankpin to determine new bearing size required.
5. Measure new or used bearing clearances with Plastigage or its equivalent.

IMPORTANT: If a bearing is being fitted to an out-of-round crankpin, be sure to fit to maximum diameter of crankpin. If bearing is fitted to minimum diameter, and crankpin is out-of-round .001" (.025mm) or more, interference between bearing and crankpin will result in rapid bearing failure.

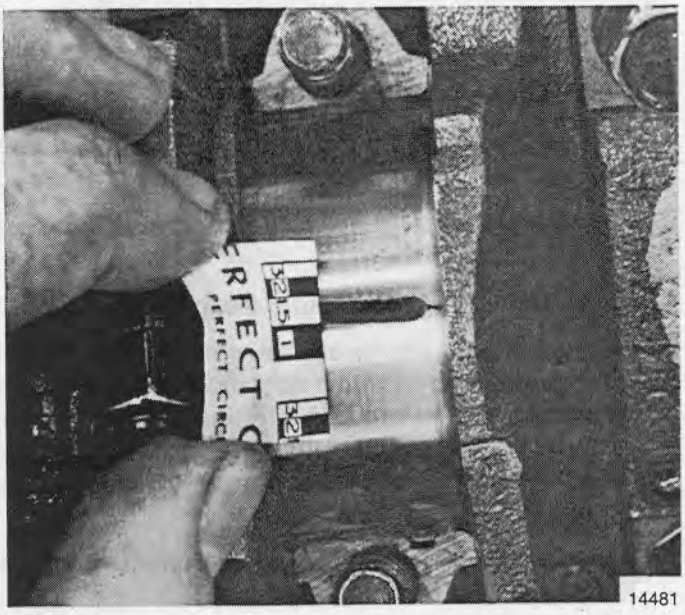
   a. Install bearing in connecting rod and cap.
   b. Place a piece of gauging plastic the full width of crankpin (parallel to crankshaft).


14479

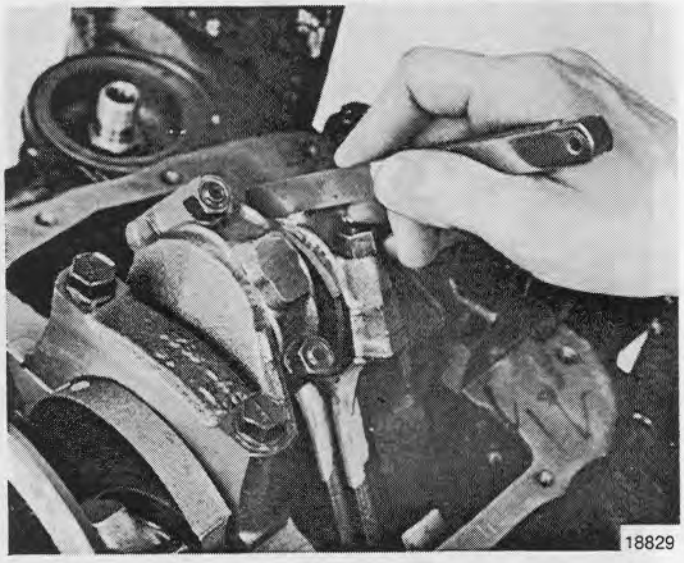
c. Install bearing cap and torque nuts evenly to 45 lbs. ft. (61.0 N.m).

IMPORTANT: Do not turn crankshaft with gauging plastic installed.

d. Remove bearing cap and, using scale on gauging plastic envelope, measure gauging plastic width at the widest point.


14481

6. If clearance exceeds specifications, select a new, correct size bearing and recheck clearance.
7. Coat bearing surface with oil, install rod cap and torque nuts to 45 lbs. ft. (61.0 N.m).
8. When all connecting rod bearings have been installed, tap each rod lightly (parallel to crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (see specifications) between connecting rod caps.


18829

Connecting Rod/Piston Assembly

REMOVAL

1. With oil pan, oil pump and cylinder head removed, use a ridge reamer to remove any ridge and/or deposits from upper end of cylinder bore.

IMPORTANT: Before ridge and/or deposits are removed, turn crankshaft until piston is at bottom of stroke and place a cloth on top of piston to collect cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke, then remove cloth and cuttings.

2. Mark connecting rod and bearing caps left bank 1, 3, 5, right bank 2, 4, 6, from front to rear on same side as piston thrust.
3. Remove connecting rod cap and install tool J-5239 (3/8") on bolts. Push connecting rod and piston assembly out of top of cylinder block.

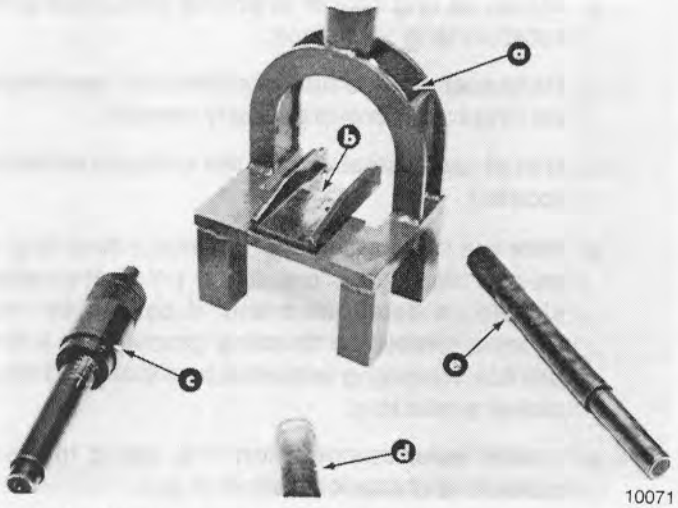
NOTE: It will be necessary to turn crankshaft slightly to disconnect and remove some connecting rod and piston assemblies.

18827

a - J-5239 Tool

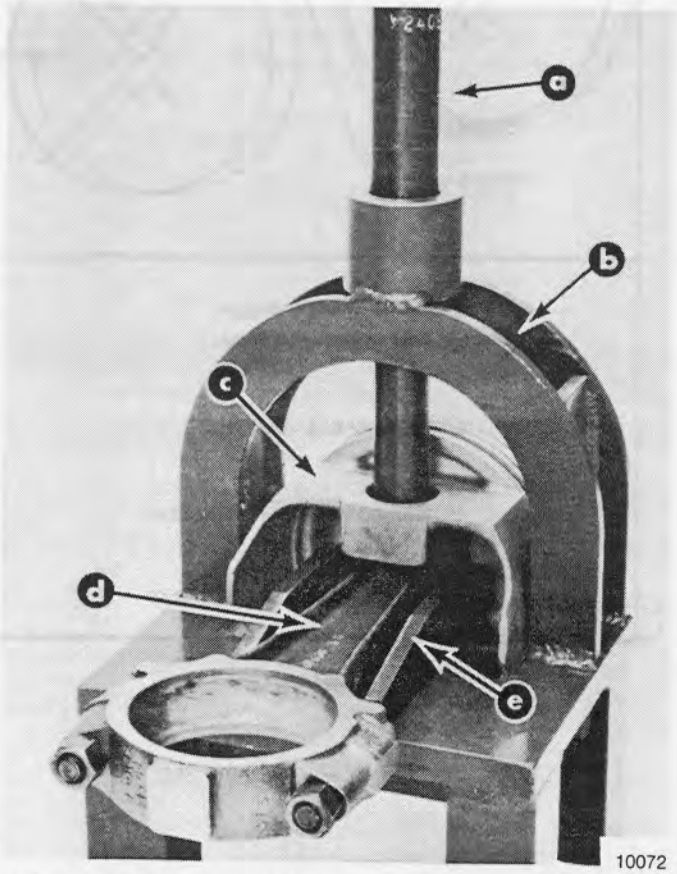
DISASSEMBLY

1. Use Tool Kit J-24086-100.



a - Arched Base
b - Rod Support
c - Adjustable Installer
d - Piston Pin Guide
e - Piston Pin Remover

2. Position connecting rod onto tool rod support with rod support inserted between connecting rod end and piston. Align piston pin with hole located in top of arched base.
3. Insert pin remover thru hole (located in top of arched base) and into piston pin hole. Press on pin remover to remove piston pin.



a - Piston Pin Remover
b - Arched Base
c - Piston
d - Connecting Rod
e - Rod Support

CLEANING and INSPECTION

Connecting Rods:

1. Wash connecting rods in cleaning solvent and dry with compressed air.
2. Check for twisted or bent rods and inspect for nicks or cracks. Replace damaged connecting rods.

Pistons:

1. Clean varnish from piston skirts and pins with a cleaning solvent. Do not wire brush any part of piston. Clean ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.
2. Inspect piston for cracked ring lands, skirts or pin bosses, wavy worn ring lands, scuffed or damaged skirts or eroded areas at top of piston. Replace pistons which are damaged or show signs of excessive wear.
3. Inspect grooves for nicks or burrs that might cause rings to hang up.
4. Measure piston skirt and check clearance as outlined under "Piston Selection - Cylinder Block".

Piston Pins:

1. Piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, piston and piston pin are a matched set and not serviced separately.
2. Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when measured. Measure piston pin with a micrometer and piston pin bore with a dial bore gauge or inside micrometer. If clearance is in excess of the .001" (.025mm) wear limit, replace piston and piston pin assembly.

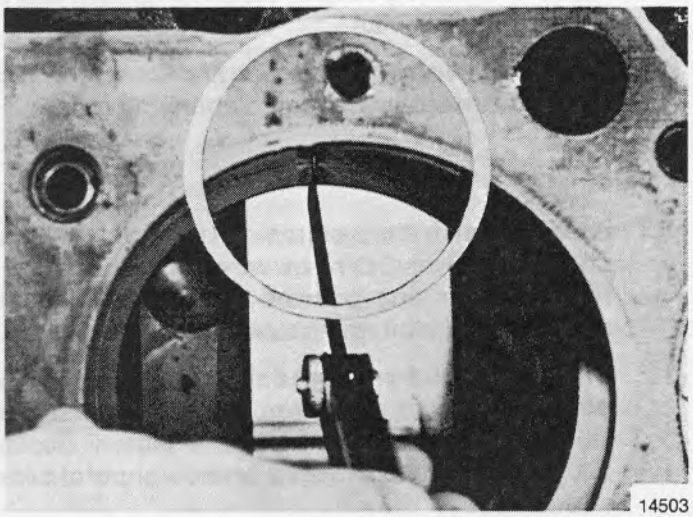
Piston Rings:

All compression rings are marked on upper side of ring. When installing compression rings, make sure that marked side is toward top of piston.

Oil control rings are a 3-piece type, consisting of 2 segments (rails) and a spacer.

1. Select rings comparable in size to piston being used.
2. Slip compression ring in cylinder bore, then press ring down into cylinder bore about 1/4" (6mm) (below ring travel). Be sure that ring is square with cylinder wall.

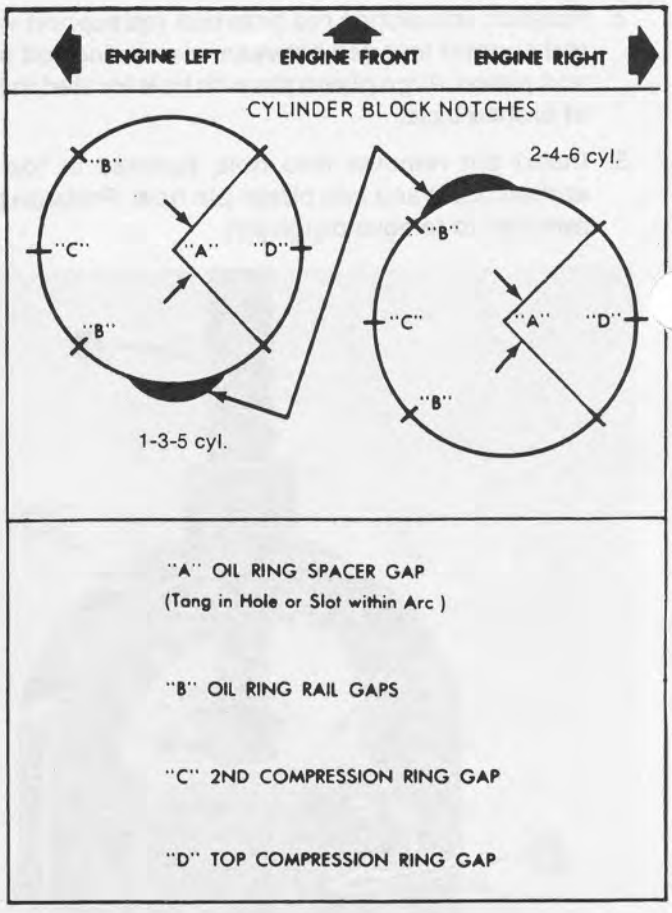
3. Measure gap between ends of ring with a feeler gauge.


14503

4. If gap between ends of ring is below specifications, remove ring and try another for fit.
5. Fit each compression ring to cylinder in which it is going to be used.
6. Clean and inspect pistons, if not previously done.
7. Slip outer surface of top and second compression ring into respective piston ring groove and roll ring entirely around the groove to make sure that ring is free. If binding occurs at any point, determine cause. If caused by ring groove, remove by dressing with a fine cut file. If binding is caused by a distorted ring, check a new ring.

14504

8. Install piston ring as shown. Use 91-24697 piston ring expanders for compression ring installation.
   a. Install oil ring spacer in groove and insert anti-rotation tang in oil hole.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point, the cause should be determined and, if caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.
   e. Install lower compression ring, using ring expander, and check location of gap.
   f. Install top compression ring with gap properly located.



9. Proper clearance of piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, clearances between ring and groove surfaces should be measured. See "Specifications".

14505

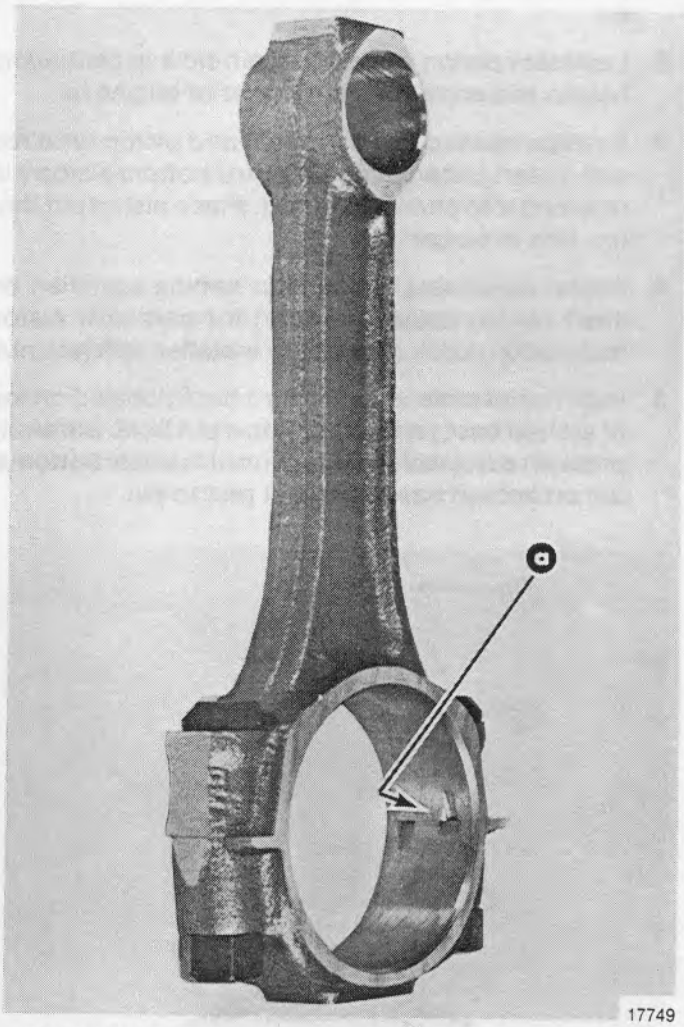
REASSEMBLY

IMPORTANT: When reassembling pistons and connecting rods, the following must be kept in mind:

A - Piston and pin are machine fitted to each other and must remain together as a matched set. Do not intermix pistons and pins.

B - If original pistons and/or connecting rods are being used, be sure to assemble pistons and connecting rods so they can be reinstalled in same cylinder from which they were removed.

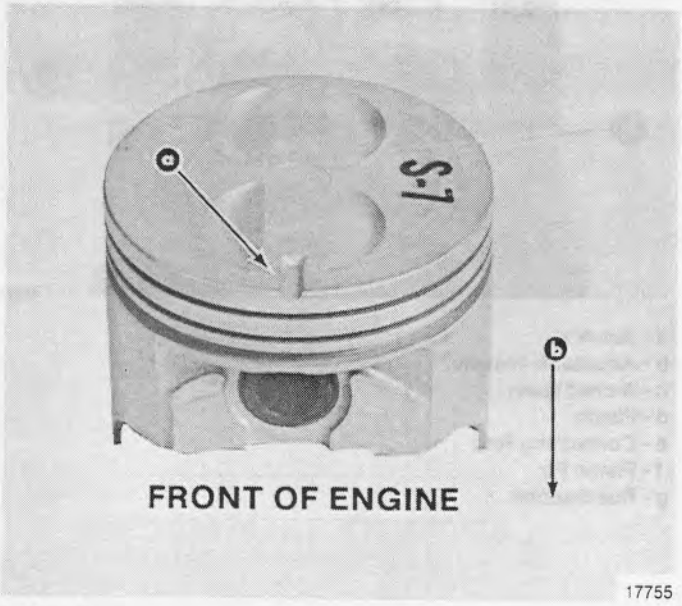
1. Connecting rod bearing tangs are always toward outside of cylinder block.



17749

a - Toward Outside

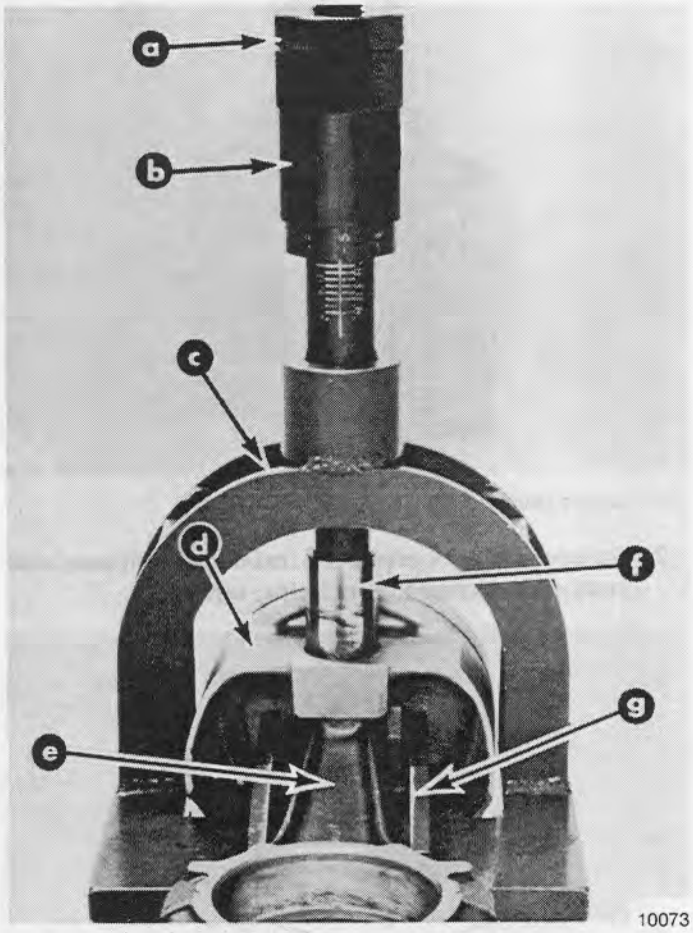
2. Reference mark on piston, must be positioned correctly for engine that is being repaired.



17755

a - Notch
b - Notch Toward Front of Engine

1. Install piston pin with Tool Kit J-24086-100. Refer to chart (furnished with Tool) and select proper size piston pin guide for specific engine being worked on.
2. Lubricate piston pin, piston pin hole in piston and hole in rod end with a light coat of engine oil.
3. Position rod onto rod support and piston onto rod end. Insert piston pin guide thru bottom piston pin hole and into connecting rod. Place piston pin thru top side of piston.
4. Adjust adjustable installer to setting specified on chart (which came with tool) for particular piston installation. Lock adjustable installer with jam nut.
5. Insert adjustable installer thru hole (located on top of arched base) and into piston pin hole. Carefully press on adjustable installer until installer bottoms-out on arched base to install piston pin.



10073

a - Jam Nut
b - Adjustable Installer
c - Arched Base
d - Piston
e - Connecting Rod
f - Piston Pin
g - Rod Support

6. Check piston for freedom of movement in piston pin bores by moving connecting rod back-and-forth and up-and-down. Connecting rod should move freely (with no resistance) in both directions. If it does not, piston pin is tight in piston pin bores and piston and pin assembly must be replaced.
7. If a new connecting rod has been installed, mark connecting rod and cap (on side of rod and cap with slots for connecting rod bearing tangs) with cylinder number in which it will be installed.

INSTALLATION

IMPORTANT: Cylinder bores must be clean before piston installation. Clean with a light honing, as necessary. Then clean with hot water and detergent wash. After cleaning, swab bores several times with light engine oil and a clean cloth, then wipe with a clean dry cloth.

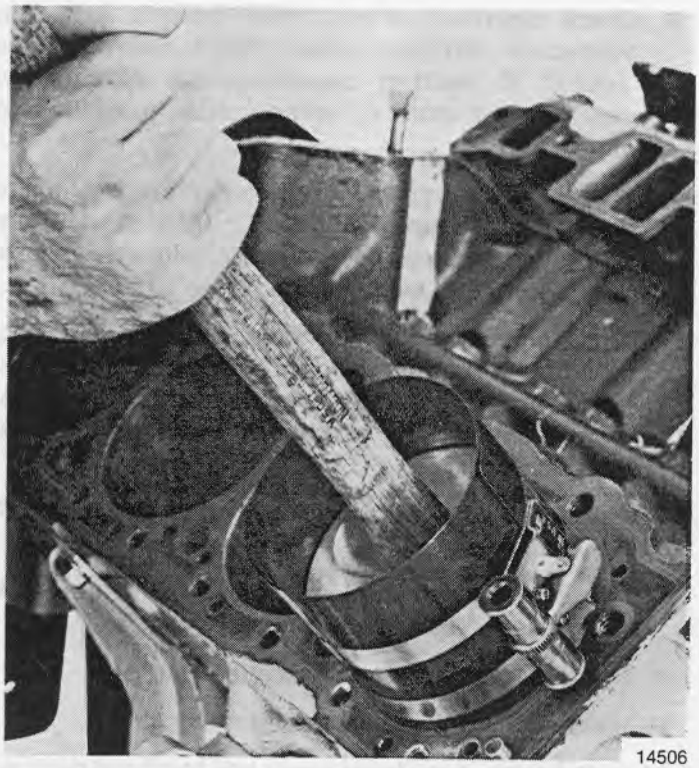
1. Lubricate connecting rod bearings and install in rods and rod caps.
2. Lightly coat pistons, rings and cylinder walls with light engine oil.
3. With bearing caps removed, install tool J-5239 (3/8") on connecting rod bolts.

18827

a - J-5239 Tool

4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tangs toward outside of cylinder block. Use tool J-8307 to compress rings. Guide connecting rod into place on crankshaft journal with tool J-5239. Use a hammer handle with light blows to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

IMPORTANT: Be sure ring gaps are properly positioned as previously outlined.



14506

IMPORTANT: Be sure to install new pistons in same cylinders for which they were fitted, and used pistons in same cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at front of engine (1, 3, 5 in left bank and 2, 4, 6 in right bank). Numbers on connecting rod and bearing cap must be on same side when installed in cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and connecting rod should be numbered to correspond with new cylinder number.

5. Remove tool J-5239.
6. Install bearing caps and torque nuts to 45 lbs. ft. (61 N.m).
7. Check connecting rod side clearance.

IMPORTANT: If bearing replacement is required, refer to "Connecting Rod Bearings".

8. Install the following items:
   a. Oil Pump
   b. Oil Pan
   c. Cylinder Head
9. Install engine in boat.
10. Fill crankcase with oil.
11. Start engine, adjust timing and check for leaks.

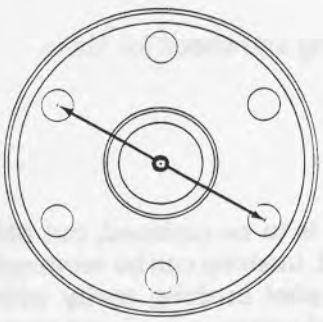
Crankshaft

IMPORTANT: If crankshaft is to be replaced, but old pilot bushing is to be reused, bushing can be removed without damage by filling pilot bushing cavity with grease, then, inserting an old transmission input shaft in bore of bushing and hitting it with a hammer. This will create hydraulic pressure in pilot bushing cavity which should force bushing out.

REMOVAL

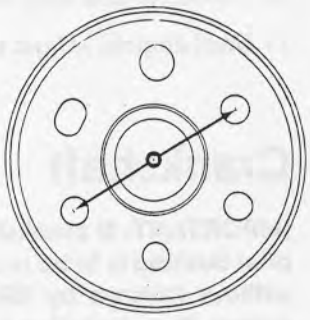
1. Remove engine from boat.
2. Drain coolant and crankcase oil. Disconnect all hoses.
3. Remove starter motor, flywheel housing and flywheel. Place engine in repair stand.
4. Remove belts, crankshaft pulley and water pump.
5. Remove torsional damper and crankcase front cover.
6. Remove spark plugs.
7. Remove camshaft sprocket and timing chain.
8. Remove oil pan and oil pump.
9. Make sure all bearing caps (main and connecting rods) are marked so they can be installed in their original locations.
10. Remove connecting rod bearing caps, then push piston and rod assemblies toward heads.
11. Remove main bearing caps and carefully lift crankshaft out of cylinder block. Remove rear main bearing oil seal from cylinder block and rear main bearing cap.
12. If new main and/or connecting rod bearings are to be installed, remove main bearing inserts from cylinder block and bearing caps, and/or connecting rod bearing inserts from connecting rod and caps. Install new bearings following procedures outlined. (See "Index".)

IMPORTANT: General Motors has changed the V-6 and V-8 cylinder block and crankshaft to incorporate a one-piece, full-circle rear seal. For this change to be made, General Motors had to redesign the cylinder block and crankshaft. New style cylinder blocks also have an aluminum carrier attached to the rear seal area for seal retention.



a - 3-5/8" (92mm)

OLD STYLE



a - 3" (76mm)

NEW STYLE

CLEANING and INSPECTION

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure main bearing journals and crankpin dimensions with a micrometer for out-of-round, taper or undersize (see "Specifications").
3. Check crankshaft for runout (by supporting at front and rear main bearings journals in "V" blocks) and check at front and rear intermediate journals with a dial indicator (see "Specifications").
4. Replace or recondition crankshaft if not meeting specifications.

INSTALLATION

1. If a new crankshaft is being installed, proceed as follows:
   a. Remove timing sprocket or gear from old crankshaft and reinstall on new crankshaft.
   b. Remove flywheel attaching studs from old crankshaft, using heat if necessary. Reinstall studs in new crankshaft with Loctite-A applied to threads.

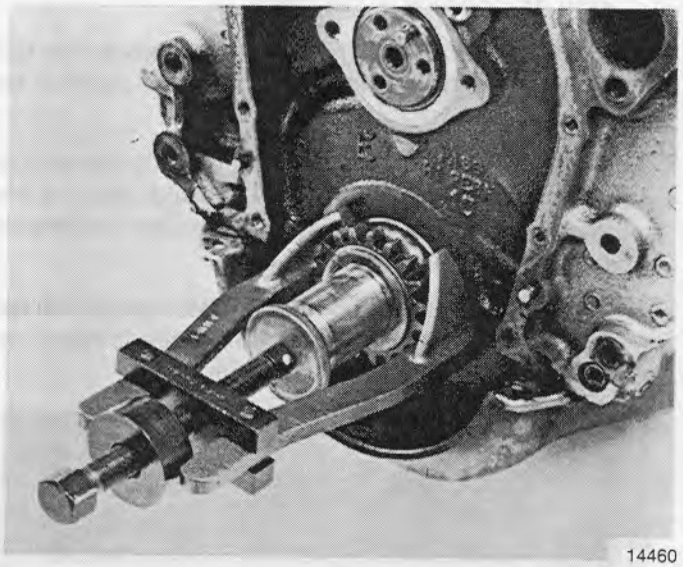
IMPORTANT: Be sure that all bearings and crankshaft journals are clean.

2. Install a new rear main bearing oil seal in cylinder block and rear main bearing cap.
3. Carefully lower crankshaft into place. Be careful not to damage bearing surface.
4. Check clearance of each main bearing, following procedure outlined under "Main Bearing"; see "Index". If bearing clearances are satisfactory, apply a light coat of engine oil to journals and bearings.
5. Install all bearing caps and bolts. Torque all main bearing cap bolts to 85 lbs. ft. (115 N.m) when tightening rear main bearing cap. Follow procedure outlined under "Main Bearing"; see "Index".
6. Check clearance for each connecting rod bearing, following procedure under "Connecting Rod Bearings"; see "Index". If bearing clearances are satisfactory, apply a light coat of engine oil to journals and bearings.
7. Install all rod caps and torque nuts to 45 lbs. ft. (61 N.m).
8. Check crankshaft end play. Follow procedure outlined under "Main Bearing"; see "Index".
9. Install oil pump and pan as outlined.
10. Install camshaft sprocket and timing chain.
11. Install crankcase front cover and torsional damper.
12. Remove engine from repair stand and install water pump, flywheel, flywheel housing and starter motor.
13. Install crankshaft pulley and belts.
14. Install spark plugs.
15. Install engine in boat, fill crankcase and install hoses.

Crankshaft Sprocket

REMOVAL

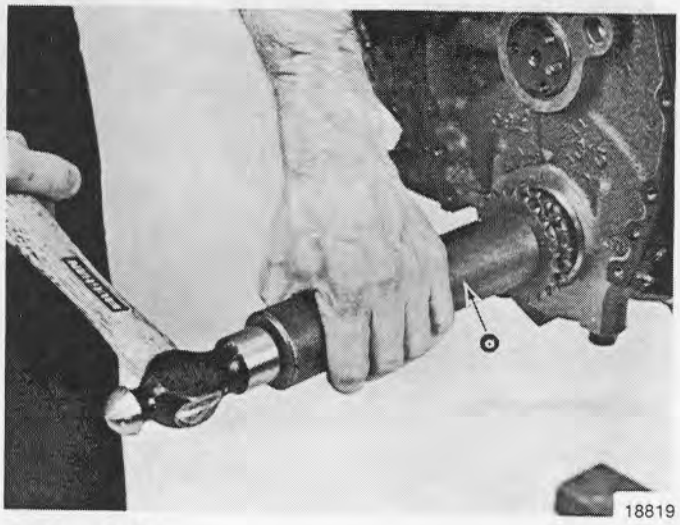
1. Remove torsional damper and crankcase front cover as outlined.
2. Remove camshaft timing chain as outlined.
3. Using Tool J-5825 remove sprocket.



14460

INSTALLATION

1. Using Tool J-5590 as shown, install sprocket or gear.
2. Install camshaft timing chain as outlined.
3. Install crankcase front cover and torsional damper as outlined.



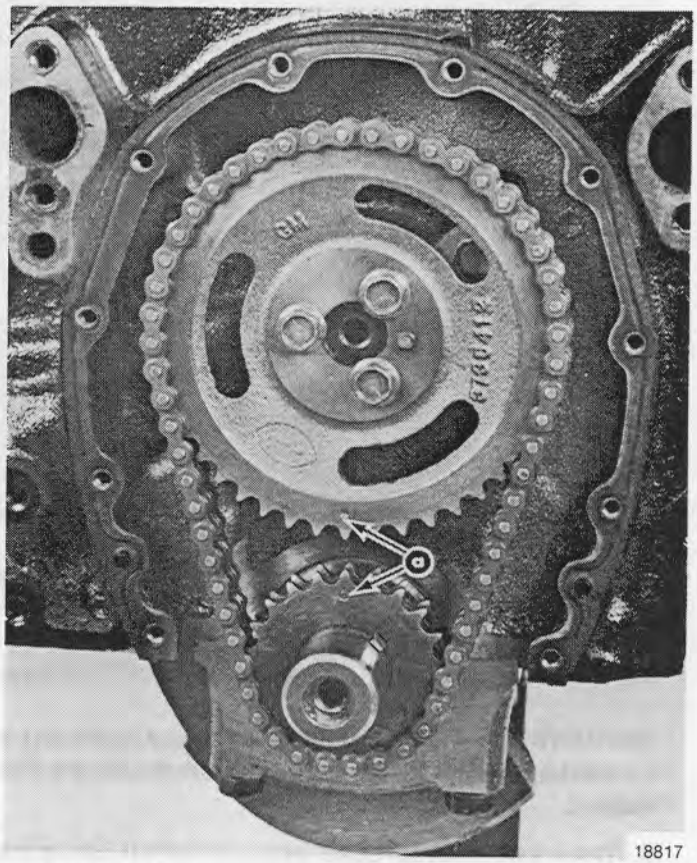
18819

a - Tool J-5590

Timing Chain/Sprockets

REMOVAL

1. Remove torsional damper and crankcase front cover as outlined.
2. Crank engine until marks on camshaft and crankshaft sprockets are in alignment.



18817

a - Alignment Marks

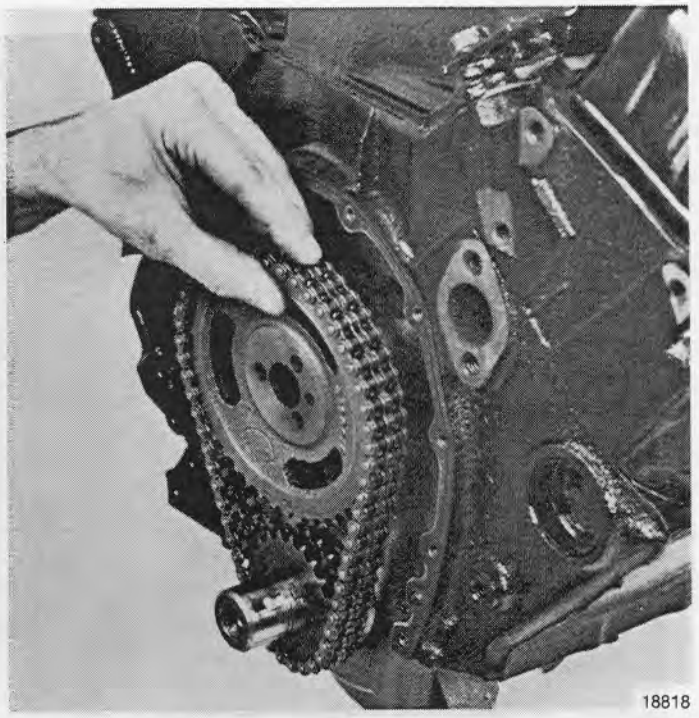
3. Remove camshaft sprocket to camshaft bolts.
4. Remove camshaft sprocket and timing chain together. Sprocket is a light press fit on camshaft. If sprocket does not come off easily, a light blow on lower edge of sprocket (with a plastic mallet) should dislodge the sprocket.
5. If crankshaft sprocket has to be replaced, remove as outlined in "Crankshaft Sprocket".

CLEANING and INSPECTION

1. Clean all parts in solvent and dry with compressed air.
2. Inspect timing chain for wear or damage.
3. Inspect sprockets for wear or damage.

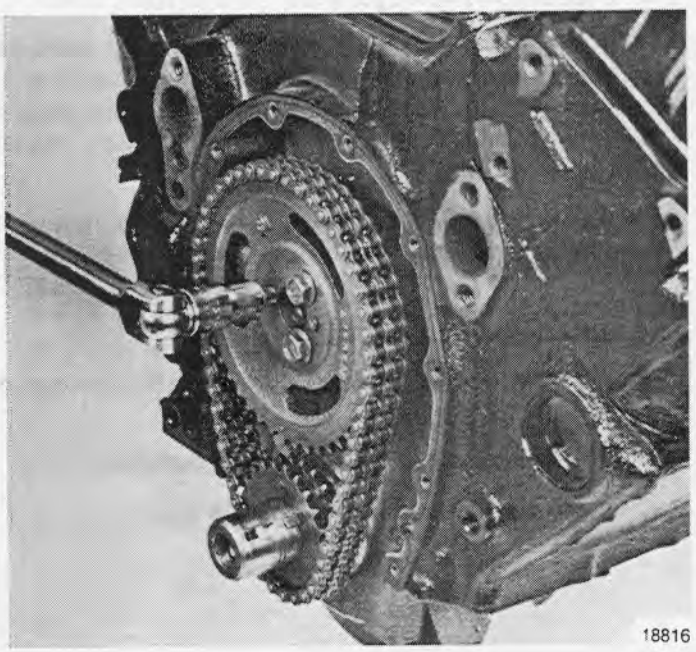
INSTALLATION

1. If crankshaft sprocket was removed, install as outlined in "Crankshaft Sprocket".
2. Install timing chain on camshaft sprocket. Hold sprocket vertical with chain hanging down and orient to align marks on camshaft and crankshaft sprockets.


18818

IMPORTANT: Do not attempt to drive sprocket on camshaft, as welsh plug at rear of engine can be dislodged.

3. Draw camshaft sprocket onto camshaft, using the 3 mounting bolts. Torque to 20 lbs. ft. (27.1 N.m).

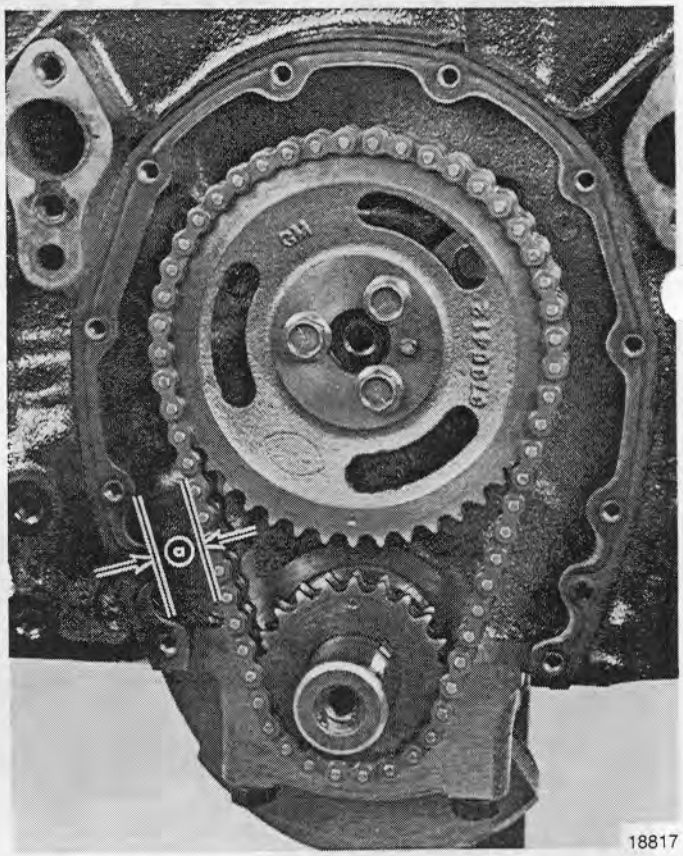

18816

4. Lubricate timing chain with engine oil. Install crankcase front cover and torsional damper as outlined.

CHECKING TIMING CHAIN DEFLECTION

With timing chain and sprockets installed, check timing chain deflection, as follows:

1. Rotate camshaft (in either direction) to place tension on one side of the chain.
2. Establish a reference point on the block (on taut side of chain) and measure from this point to the chain.
3. Rotate camshaft in the opposite direction to slacken the chain, then force chain out with fingers and again measure the distance between reference point and timing chain.
4. The deflection is the difference between these two measurements. If the deflection exceeds specifications, timing chain should be replaced.


18817

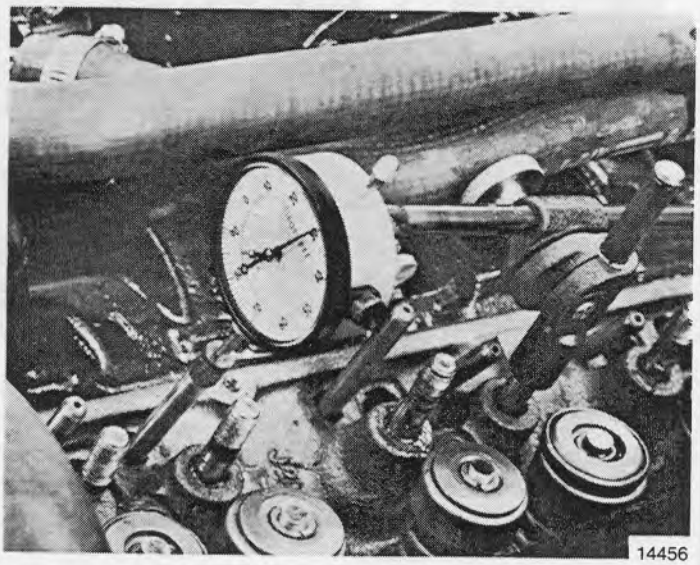
a - Reference Point

Camshaft

MEASURING LOBE LIFT

NOTE: Procedure is similar to checking valve timing. If improper valve operation is indicated, measure lift of each push rod in consecutive order and record readings.

1. Remove valve mechanism as outlined.
2. Position indicator with ball socket adapter Tool J-8520-1 on push rod. Be sure that push rod is in lifter socket.

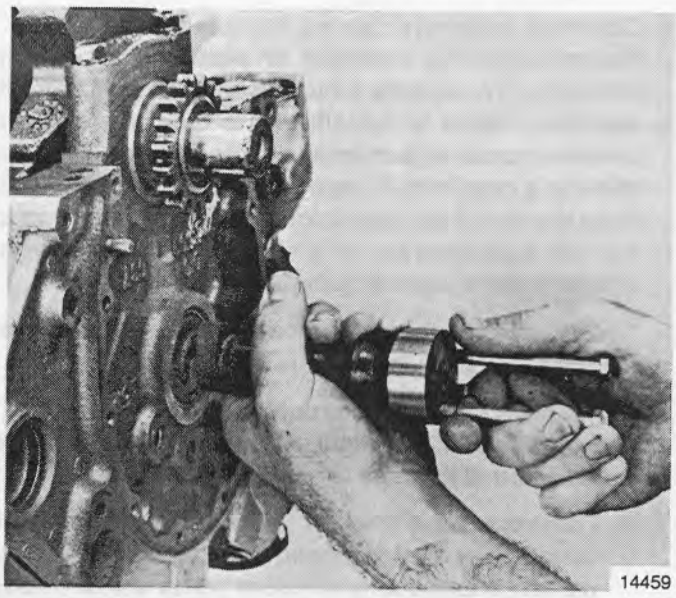

14456

Measuring Camshaft Lobe Lift

3. Rotate crankshaft damper slowly in direction of rotation until lifter is on heel of cam lobe. At this point, push rod will be in its lowest position.
4. Set dial indicator on zero, then rotate balancer slowly (or attach an auxiliary starter switch and "bump" engine over) until push rod is in fully raised position.
5. Compare total lift, recorded from dial indicator, with "Specifications".
6. Continue to rotate engine until indicator reads zero. This will be a check on accuracy of original indicator reading.
7. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
8. Install and adjust valve mechanism as outlined.

REMOVAL

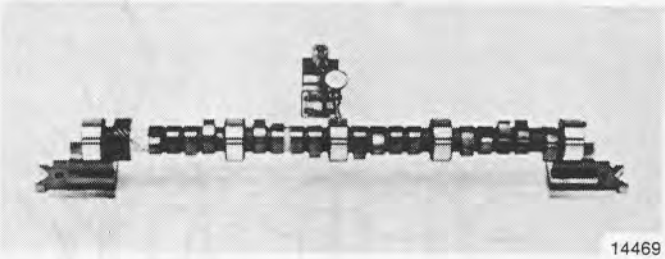
1. Remove valve lifters as outlined.
2. Remove crankcase front cover as outlined.
3. Remove fuel pump and fuel pump push rod.
4. Remove camshaft as follows:
   a. Refer to "Timing Chain/Sprockets, Left-Hand (Standard) Rotation Engines" to remove chain and sprocket.
   b. Install two 5/16-18 bolts in camshaft sprocket bolt holes and carefully remove camshaft.


14459

INSPECTION

Measure camshaft bearing journals with a micrometer for out-of-round condition. If journals exceed .001" (.025mm) out-of-round, camshaft should be replaced.

Also check camshaft for alignment with "V" blocks and dial indicator which indicates exact amount camshaft is out-of-true. If out more than .002" (.051mm) (dial indicator reading) camshaft should be replaced.


14469

INSTALLATION

1. Install camshaft as follows:
   a. Install two 5/16-18 bolts in camshaft bolt holes, then lubricate camshaft journals with engine oil and install camshaft, being careful not to damage bearings. Remove the two 5/16-18 bolts.
   b. Install timing chain and sprocket as outlined in "Timing Chain/Sprockets".

Camshaft Bearings

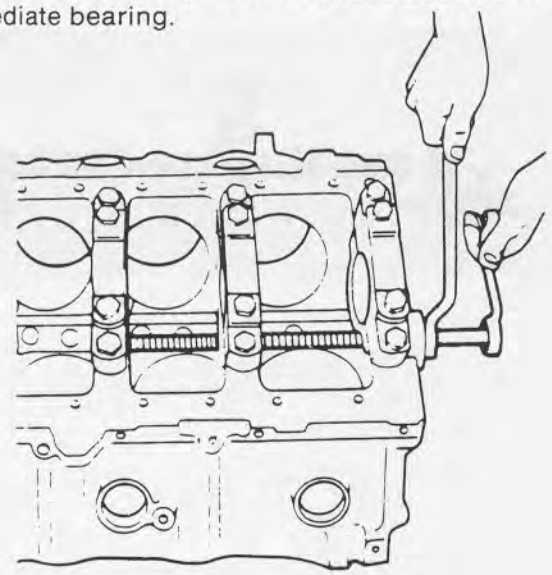
REMOVAL

Camshaft bearings can be replaced while engine is disassembled for overhaul or without complete disassembly. To replace bearings without complete disassembly, remove camshaft and crankshaft, leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Fasten connecting rod against sides of engine so that they will not interfere while replacing camshaft bearings.

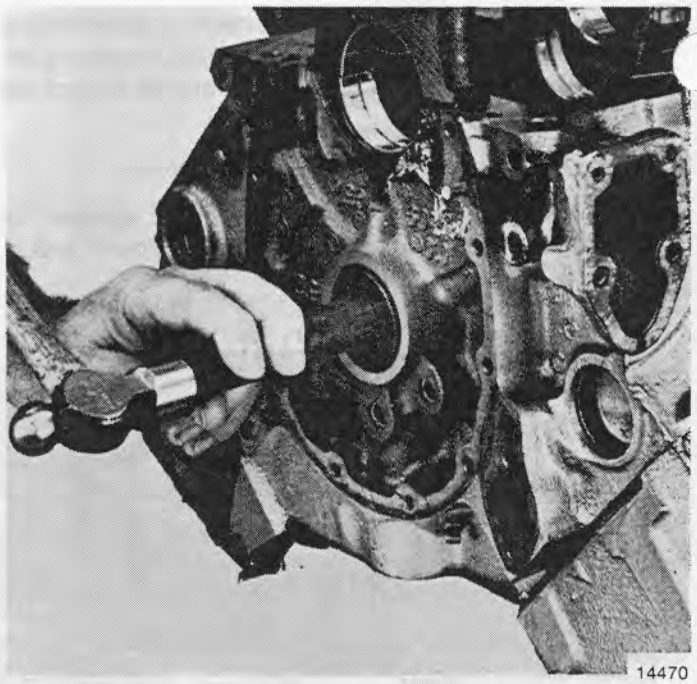
1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.

IMPORTANT: This procedure is based on removal of bearings center of engine first, thus requiring a minimum amount of turns to remove all bearings.

2. Using tool set J-6098-01 (with nut and thrust washer installed to end of threads), position pilot in front camshaft bearing and install puller screw through pilot.
3. Install tool with shoulder toward bearing. Be sure a sufficient amount of threads are engaged.
4. Using 2 wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove tool and bearing from puller screw.
5. Remove remaining bearings (except front and rear) in same manner. It will be necessary to position pilot in rear camshaft bearing to remove rear intermediate bearing.



6. Assemble remover tool on driver handle and remove front and rear camshaft bearings by driving toward center of cylinder block.



INSPECTION

Clean camshaft bearing bores in cylinder block with solvent and blow out with compressed air. Be sure grooves and drilled oil passages are clean.

INSTALLATION

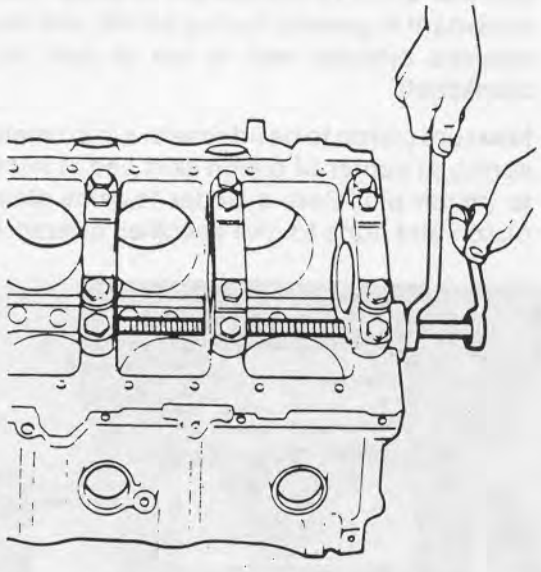
Front and rear bearings must be installed last as pilot will not fit into bearing bores if bearings are installed.

Lubricate outer surface of new camshaft bearings with engine oil to ease installation.

IMPORTANT: All camshaft bearings are not the same. Be sure to install bearing in proper location (indicated by bearing manufacturer) and to position bearings as follows: (Directional references are in reference to engine in its normal operating position.)

Front bearing must be positioned so that oil holes are equal distance from 6 o'clock position in the block. Intermediate and center bearings must be positioned so that oil holes are at the 5 o'clock position (toward left side of block and at a position even with bottom of cylinder bore). Rear bearing must be positioned so that oil hole is at the 12 o'clock position.

1. **Installing Intermediate and Center Bearings:**
   a. Install nut and thrust washer all-the-way onto puller screw, then position pilot in front camshaft bearing bore and insert screw thru pilot.
   b. Index center camshaft bearing, then position appropriate size remover and installer tool in bearing and thread puller screw into tool. Be sure at least 1/2" (13mm) of threads are engaged.
   c. Using 2 wrenches, hold puller screw and turn nut until bearing has been pulled into position. Remove the remover and installer tool and check to ensure that oil hole(s) in bearing are positioned correctly.



   d. Install intermediate bearings in same manner being sure to index bearings correctly. It will be necessary to position pilot in rear camshaft bearing bore to install rear intermediate bearing.
2. **Installing Front and Rear Bearings:**
   a. Install appropriate size remover and installer tool on drive handle.
   b. Index front bearing (as explained in "Important"), and drive it into position with tool. Check position of oil hole(s) in bearing to ensure bearing is positioned correctly.
   c. Install rear bearing in same manner, being sure to index bearing correctly.
3. Install a new camshaft rear plug.

IMPORTANT: Plug must be installed flush to 1/32" (.8mm) deep and must be parallel with rear surface of cylinder block.

4. Install crankshaft and camshaft as outlined.

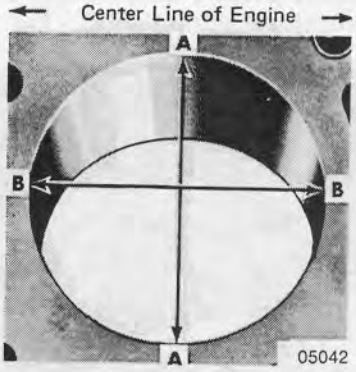
Cylinder Block

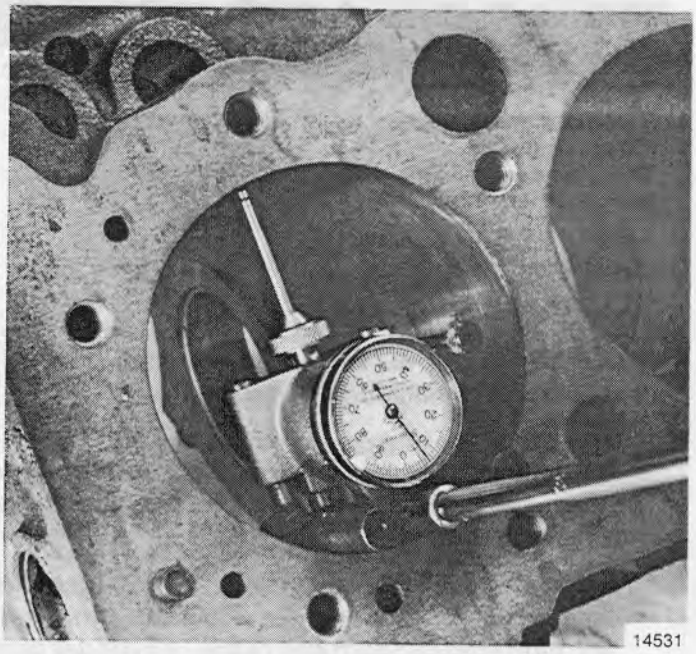
CLEANING and INSPECTION

1. Remove all engine components as previously outlined.
2. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.
3. Remove oil gallery plugs and clean all oil passages.

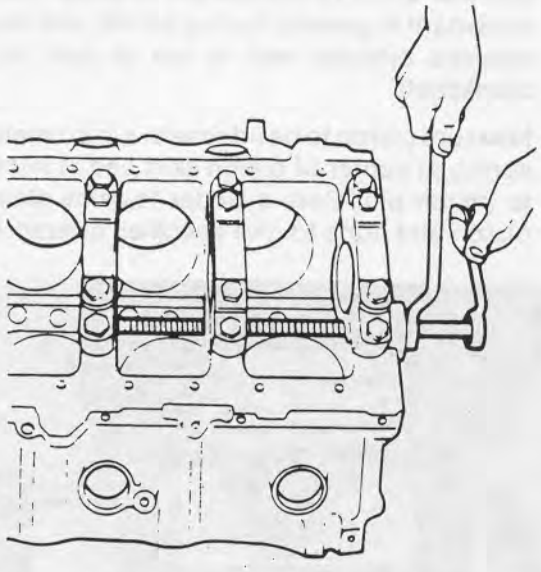
NOTE: These plugs may be removed with a sharp punch, or they may be drilled and pried out.

4. Clean and inspect water passages in cylinder block.
5. Inspect cylinder block for cracks in cylinder walls, water jacket valve lifter bores and main bearing webs.
6. Measure cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator or inside micrometer. Carefully work gauge up and down cylinder to determine taper and turn it to different points around cylinder wall to determine out-of-round condition. If cylinders exceed specifications, boring and/or honing will be necessary.





1. **Installing Intermediate and Center Bearings:**
   a. Install nut and thrust washer all-the-way onto puller screw, then position pilot in front camshaft bearing bore and insert screw thru pilot.
   b. Index center camshaft bearing, then position appropriate size remover and installer tool in bearing and thread puller screw into tool. Be sure at least 1/2" (13mm) of threads are engaged.
   c. Using 2 wrenches, hold puller screw and turn nut until bearing has been pulled into position. Remove the remover and installer tool and check to ensure that oil hole(s) in bearing are positioned correctly.



   d. Install intermediate bearings in same manner being sure to index bearings correctly. It will be necessary to position pilot in rear camshaft bearing bore to install rear intermediate bearing.
2. **Installing Front and Rear Bearings:**
   a. Install appropriate size remover and installer tool on drive handle.
   b. Index front bearing (as explained in "Important"), and drive it into position with tool. Check position of oil hole(s) in bearing to ensure bearing is positioned correctly.
   c. Install rear bearing in same manner, being sure to index bearing correctly.
3. Install a new camshaft rear plug.

IMPORTANT: Plug must be installed flush to 1/32" (.8mm) deep and must be parallel with rear surface of cylinder block.

4. Install crankshaft and camshaft as outlined.

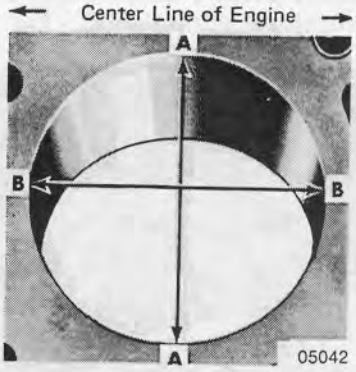
Cylinder Block

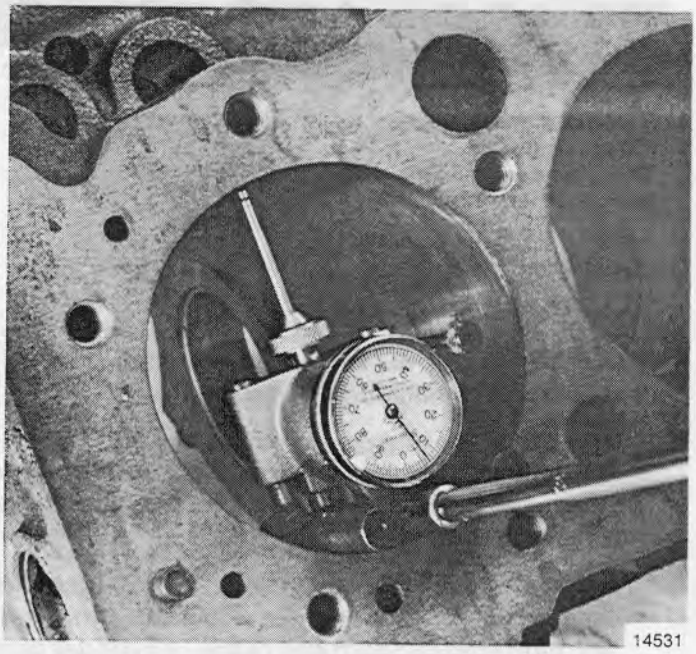
CLEANING and INSPECTION

1. Remove all engine components as previously outlined.
2. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.
3. Remove oil gallery plugs and clean all oil passages.

NOTE: These plugs may be removed with a sharp punch, or they may be drilled and pried out.

4. Clean and inspect water passages in cylinder block.
5. Inspect cylinder block for cracks in cylinder walls, water jacket valve lifter bores and main bearing webs.
6. Measure cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator or inside micrometer. Carefully work gauge up and down cylinder to determine taper and turn it to different points around cylinder wall to determine out-of-round condition. If cylinders exceed specifications, boring and/or honing will be necessary.





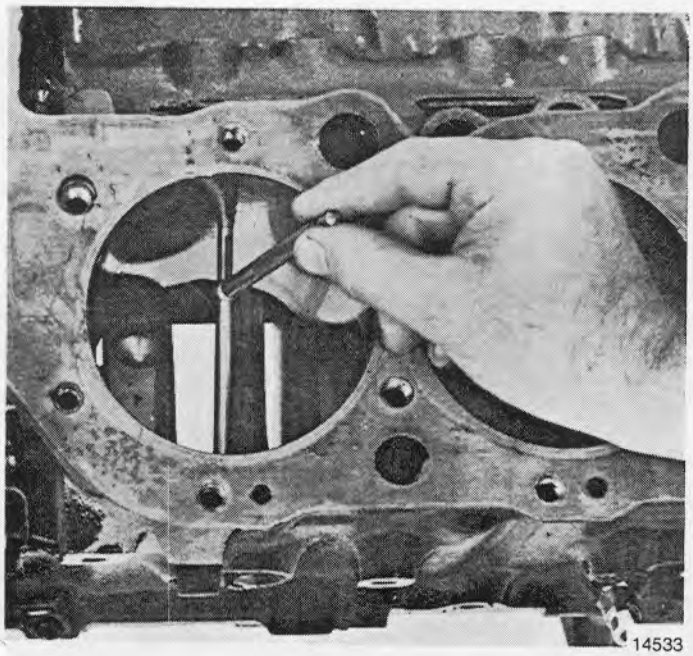
3. When finish-honing a cylinder bore to fit a piston, move hone up-and-down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of approximately 30° to cylinder bore. Finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
4. Permanently mark piston (for cylinder to which it has been fitted) and proceed to hone cylinders and fit remaining pistons.

IMPORTANT: Handle pistons with care and do not attempt to force them through cylinder, as this type piston can be distorted by careless handling.

5. Thoroughly clean cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any abrasive material remains in cylinder bores, it will rapidly wear new rings and cylinder bores in addition to bearings lubricated by the contaminated oil. Swab bores several times with light engine oil on a clean cloth, then wipe with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean remainder of cylinder block to remove excess material spread during honing operation.

Piston Selection:

1. Check used piston to cylinder bore clearance as follows:
   a. Measure "cylinder bore diameter" with a telescope gauge 2-1/2" (64mm) from top of cylinder bore.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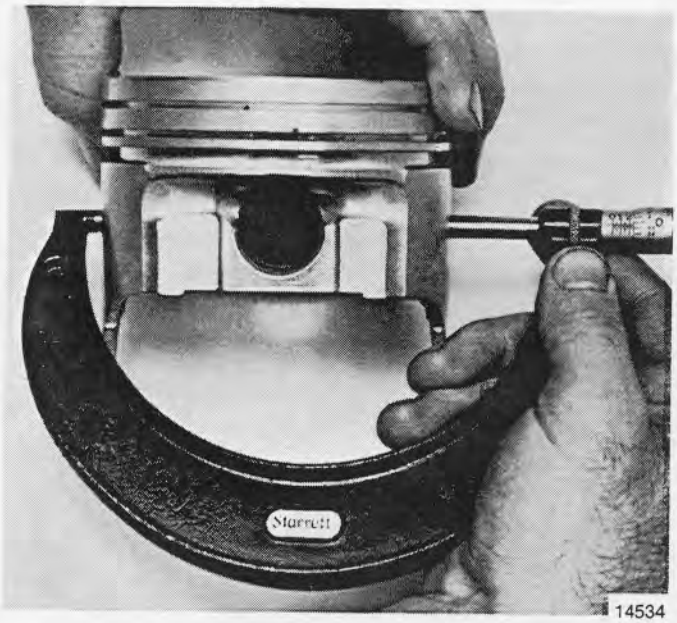
   b. Measure "piston diameter" at skirt across center line of piston pin.



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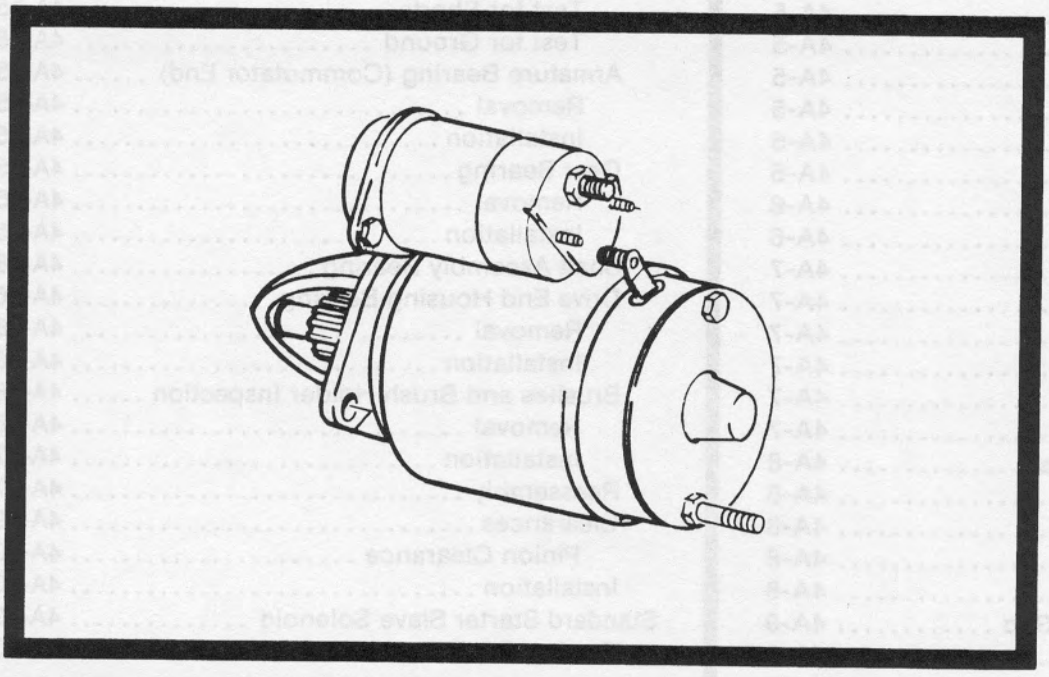
   c. Subtract piston diameter from cylinder bore diameter to determine "piston-to-bore clearance".
   d. Determine if "piston-to-bore clearance" is in acceptable range shown in "Specifications".
2. If used piston is not satisfactory, determine if a new piston can be selected to fit cylinder bore within acceptable range.
3. If cylinder bore must be reconditioned, measure new piston diameter (across centerline of piston pin), then hone cylinder bore to correct clearance (preferable range).
4. Mark piston to identify cylinder for which it was fitted.

REPLACEMENT PART INFORMATION

If replacement of cylinder block is necessary, the following must be performed:

1. Retain oil filter adaptor asseembly and related parts for use with new engine.
2. If engine being replaced has a remote oil filter, check the cylinder block being replaced to determine method used to attach cylinder block adaptor to cylinder block.

ELECTRICAL SYSTEMS



4

A

STARTING SYSTEM

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PERMANENT MAGNET GEAR REDUCTION STARTER (PMGR)

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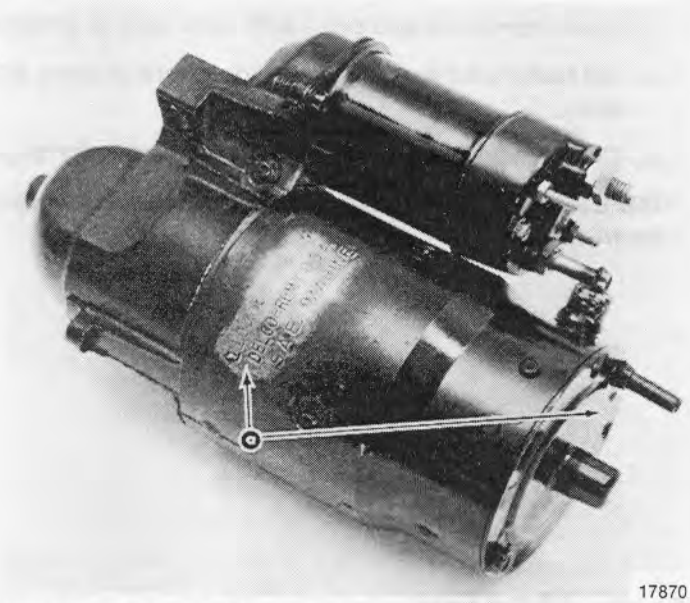
Identification

The starter identification number (a) is located as shown.



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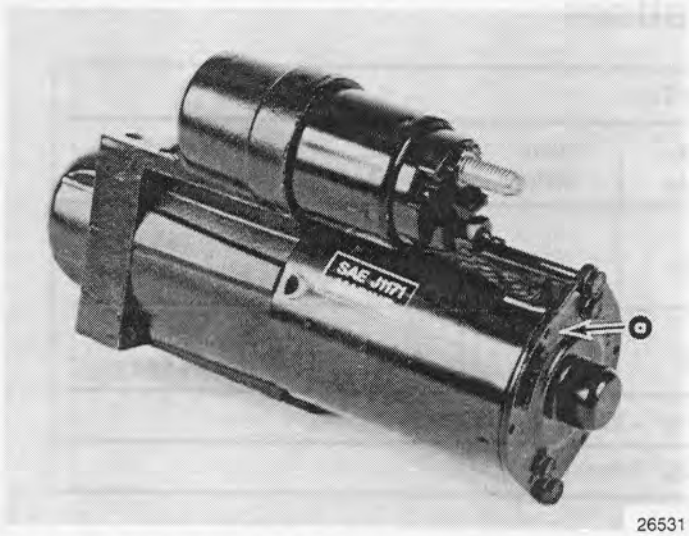
DIRECT DRIVE STARTER MOTOR



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PERMANENT MAGNET GEAR REDUCTION STARTER MOTOR (PG200)

⚠WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Battery

IMPORTANT: Terminals must be soldered to cable ends to ensure good electrical contact. Use electrical grade (resin flux) solder only. Do not use acid flux solder, as it may cause corrosion and failure.

Battery Cable

Cable Length	Cable Gauge
Up to 3-1/2 Ft. (1.1m)	4 (19mm²)
3-1/2 - 6 Ft. (1.1-1.8m)	2 (32mm²)
6 - 7-1/2 Ft. (1.8-2.3m)	1 (40mm²)
7-1/2 - 9-1/2 Ft. (2.3-2.9m)	0 (50mm²)
9-1/2 - 12 Ft. (2.9-3.7m)	00 (62mm²)
12 - 15 Ft. (3.7-4.6m)	000 (81mm²)
15 - 19 Ft. (4.6-5.8m)	0000 (103mm²)
Both positive (+) and negative (-) cables	

Maintenance

⚠WARNING

Hydrogen gases that escape from the battery during charging are explosive. Be sure that battery area is well ventilated and that bilge blower is in operation when charging. Do not smoke or allow sources of spark or open flame in area when charging battery.

⚠WARNING

Battery electrolyte is a corrosive acid and should be handled with extreme care. If electrolyte is spilled or splashed on any part of the body, immediately flush the exposed area with liberal amounts of water and obtain medical aid as soon as possible. Safety glasses and rubber gloves are recommended when handling batteries.

⚠CAUTION

To prevent damage to the electrical system be sure to adhere to the following:

a. **When installing battery, be sure to connect the (-) negative (grounded) battery cable to the (-) negative battery terminal and (+) positive battery cable to (+) positive battery terminal.**

b. **Never disconnect the battery cables while the engine is running.**

c. **If a charger or booster is to be used, be sure to connect it in parallel with existing battery (positive to positive and negative to negative).**

d. **When applying a booster charge to battery, disconnect both cables from battery (to prevent damage to voltage regulator).**

e. **Check battery condition periodically.**

f. **Make sure that battery leads are kept clean and tight.**

Testing

Place battery under heavy load (as during engine cranking or with a variable resistor tester) and test cell voltage while under load.

Certain conditions must be met before testing.

a. Battery must be between 60° and 100°.

b. Electrolyte level must be correct in all cells.

c. Battery must be at least half charged.

d. No obvious defects.

1. Check voltage per manufacturer's specifications.
2. If readings are low, recharge and retest.
3. If readings remain low, battery should be replaced.

⚠CAUTION
Test battery in well ventilated area as gases given off by battery are hazardous.

Storage

a. Remove battery and clean exterior.

b. Check fluid level and fill if low.

c. Cover terminals and bolts with light coat of grease.

d. Set battery on wood or in carton, store in cool, dry place.

e. Check every 20 days for fluid level and slow charge.

IMPORTANT: A discharged battery can be damaged by freezing.

Delco-Remy Starter Motor Specifications

No Load Test						
Identification Number	**Volts**	**Min. Amps**	**Max. Amps**	**Min. RPM**	**Max. RPM**	**Brush Spring Tension**
50-99416A1 (Delco-Remy) 1998318	10.6	60	100	5300	10,600	56 - 105 Oz. (1588 - 2976 g)
50-99416A2 1998317	10.6	70	120	5400	10,800	56 - 105 Oz. (1588 - 2976 g)
Pinion Clearance			.010" - .140" (.25 - 3.5mm)			
Commutor End Frame Gap			.025" (.6mm)			

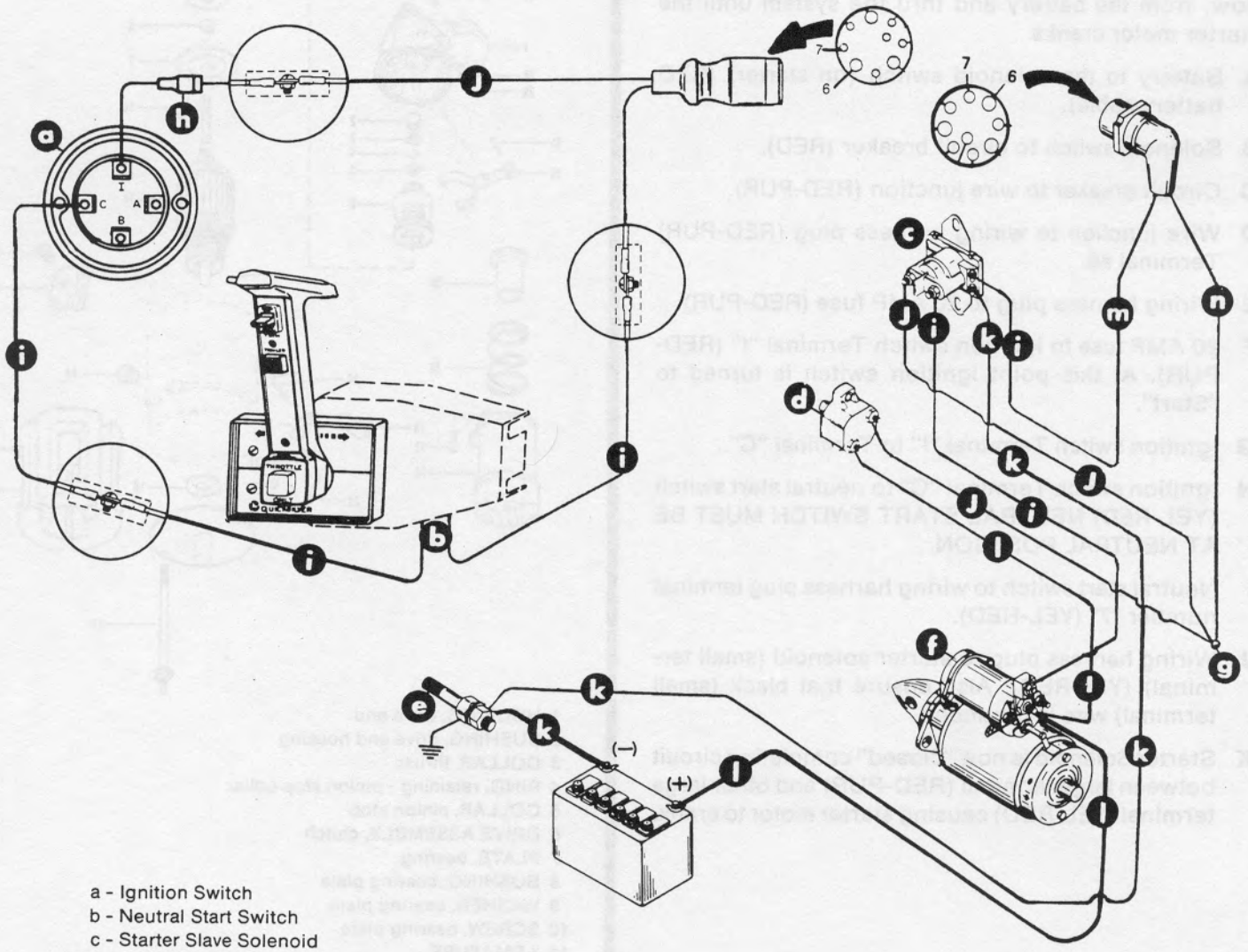
Torque Specifications

FASTENER LOCATION	LBS. FT. (N.m)	LBS. IN. (N.m)
Starter Motor to Block	50 (68)	

Lubricants-Sealants

92-25711-2 Liquid Neoprene
SAE 10W Oil
SAE 20W Oil

Starting System Components



a - Ignition Switch
b - Neutral Start Switch
c - Starter Slave Solenoid
d - Circuit Breaker
e - Engine Ground Stud
f - Starter Solenoid
g - Wire Junction
h - 20 Amp Fuse
i - Yellow-Red
j - Red-Purple
k - Black
l - Red
m - Yellow-Red 7
n - Red-Purple 6

DIAGNOSIS

This is a general description of the positive current flow, from the battery and thru the system until the starter motor cranks.

A Battery to the solenoid switch (on starter) (RED battery cable).

B Solenoid switch to circuit breaker (RED).

C Circuit breaker to wire junction (RED-PUR).

D Wire junction to wiring harness plug (RED-PUR) Terminal #6.

E Wiring harness plug to 20 AMP fuse (RED-PUR).

F 20 AMP fuse to ignition switch Terminal "I" (RED-PUR). At this point ignition switch is turned to "Start".

G Ignition switch Terminal "I" to Terminal "C".

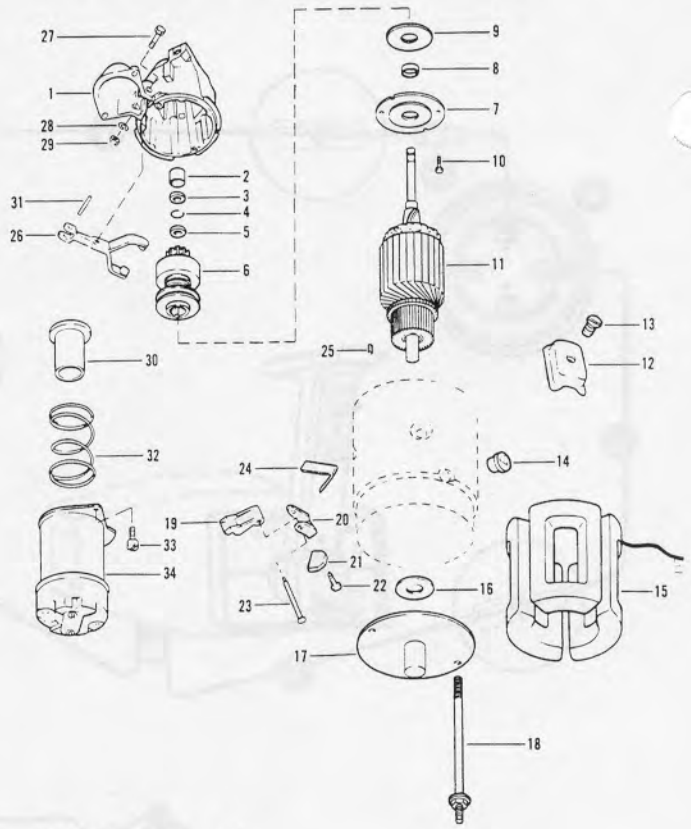
H Ignition switch Terminal "C" to neutral start switch (YEL-RED) NEUTRAL START SWITCH MUST BE AT NEUTRAL POSITION.

I Neutral start switch to wiring harness plug terminal number "7" (YEL-RED).

J Wiring harness plug to starter solenoid (small terminal) (YEL-RED). Also ensure that black (small terminal) wire is grounded.

K Starter Solenoid is now "closed" completing circuit between large terminal (RED-PUR) and other large terminal (YEL-RED) causing starter motor to crank.

Starter Motor Assembly



1 HOUSING, drive end
2 BUSHING, drive end housing
3 COLLAR, thrust
4 RING, retaining - pinion stop collar
5 COLLAR, pinion stop
6 DRIVE ASSEMBLY, clutch
7 PLATE, bearing
8 BUSHING, bearing plate
9 WASHER, bearing plate
10 SCREW, bearing plate
11 ARMATURE
12 SHOE, pole - field coil
13 SCREW, pole shoe to field coil
14 GROMMET, field coil - field frame
15 FIELD COIL ASSEMBLY
16 WASHER, leather - commutator end frame
17 FRAME, commutator end - lower
18 BOLT, thru
19 HOLDER, insulated - field frame brush
20 HOLDER, field frame brush ground
21 BRUSH, field frame
22 SCREW, brush lead
23 SUPPORT PACKAGE, ground and insulated holders
24 SPRING, field frame brush
25 PIN, dowel - field frame
26 LEVER, shift
27 STUD, shift lever
28 WASHER, shift lever stud
29 NUT, shift lever stud
30 PLUNGER, shift lever
31 PIN, plunger to shift lever
32 SPRING, plunger return
33 SCREW, solenoid switch
34 SOLENOID SWITCH ASSEMBLY

Periodic Inspection

Cranking motor and solenoid are completely enclosed in the drive housing to prevent entrance of moisture and dirt. However, periodic inspection is required:

a. Inspect terminals for corrosion and loose connections.

b. Inspect wiring for frayed and worn insulation.

c. Check mounting bolts for tightness.

Repair

Removal

⚠WARNING

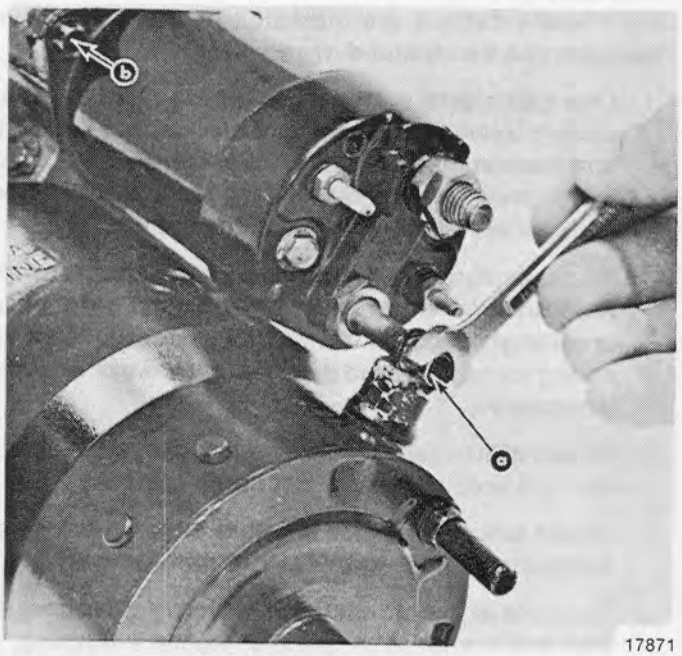
Disconnect battery cables at battery before removing starter.

1. Disconnect battery cables from battery.
2. Disconnect wires from solenoid terminals.
3. Remove starter mounting bolts.
4. Pull starter assembly away from flywheel and remove from engine.

Solenoid Switch

REMOVAL

1. Remove starter motor as outlined.
2. Remove screw from field coil connector and solenoid attaching screws.
3. Twist solenoid to disengage tab, and remove.



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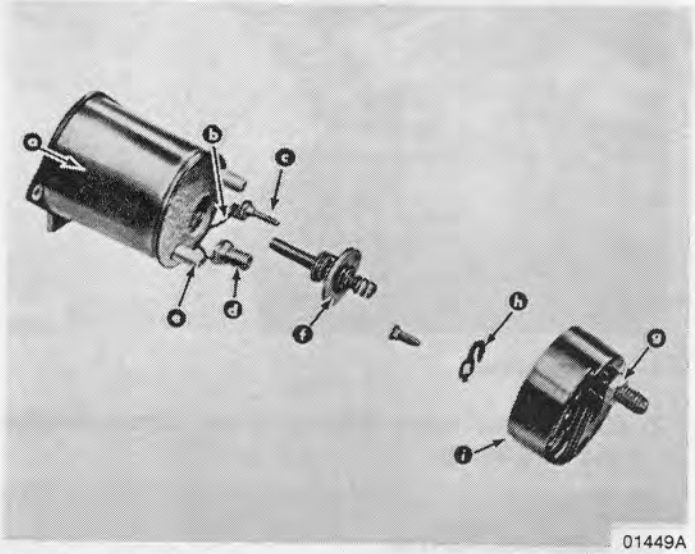
a - Field Coil Screw
b - Attaching Screws

REPLACEMENT of CONTACTS

1. With solenoid removed from motor, remove nuts and washers from switch ("S") terminal and starter motor connector strap terminal.
2. Remove solenoid end cover retaining screws and washers and remove end cover from solenoid body.
3. Remove nut and washer from battery terminal on end cover and remove battery terminal.

IMPORTANT: DO NOT cut starter motor connector strap terminal wire to remove terminal, or wire will be too short.



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a - Solenoid Body
b - To Hold in Coil
c - Switch Terminal
d - Motor Connector Strap Terminal
e - To Pull in Coil
f - Contact Ring and Push Rod Assembly
g - Battery Terminal
h - Contact Finger
i - End Cover

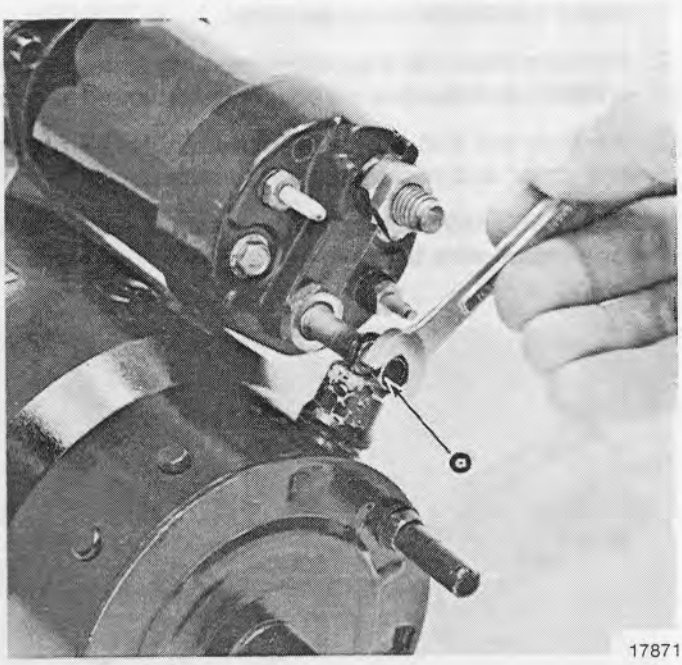
4. Remove motor connector strap terminal and solder new terminal in position.
5. Remove and install new battery terminal, washer and retaining nut to end cover.
6. Place new contact ring and push rod assembly in solenoid housing.
7. Position end cover over switch and motor terminals and install end cover retaining screws. Also install washers and nuts on solenoid switch and starting motor terminals.

INSTALLATION

1. Install solenoid onto plunger.
2. Twist solenoid to engage tab.
3. Install screws and tighten securely.
4. Install field coil connector screw.

Starter Motor Disassembly

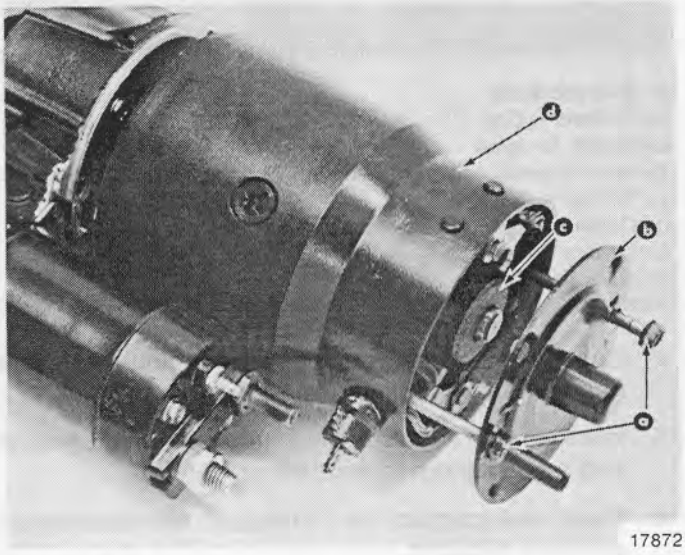
1. Remove screw from field coil connector.



17871

a - Connector Screw

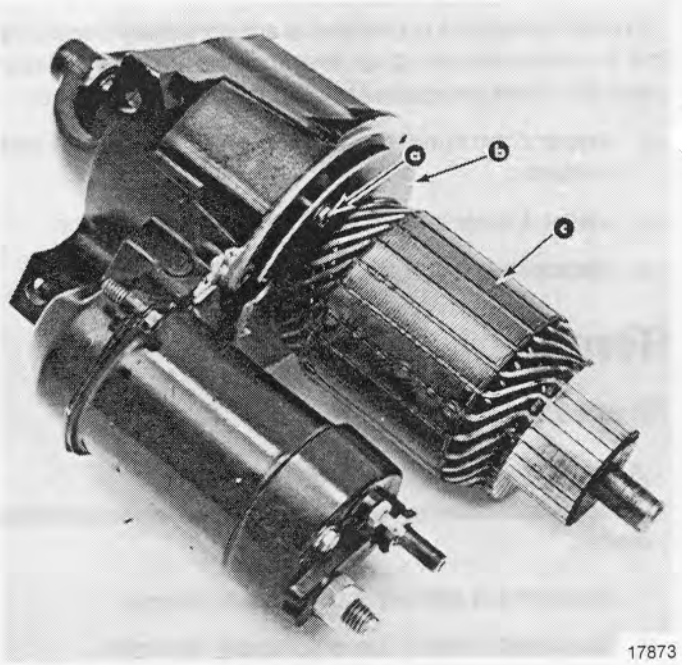
2. Remove end frame thru bolts, end frame, washer and field frame.



17872

a - Thru Bolts
b - End Frame
c - Washer
d - Field Frame

3. Remove screws, center bearing plate and armature.



17873

a - Screws
b - Bearing Plate
c - Armature

4. Slide thrust collar off armature shaft.
5. Drive retainer ring toward armature.
6. Remove snap ring, retainer and clutch assembly.

Cleaning and Inspection

With starting motor completely disassembled, except for removal of field coils, component parts should be cleaned and inspected. Field coils should be removed only where defects are indicated by tests. Defective parts should be replaced or repaired.

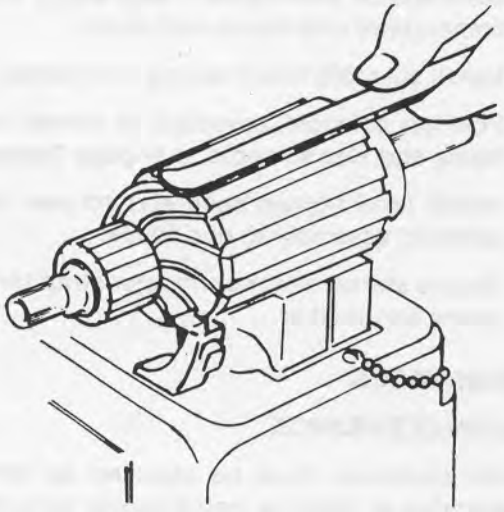
1. Clean all starting motor parts but do not use dissolving solvents for cleaning over-running clutch, armature and field coils. Such a solvent would dissolve grease packed in clutch mechanism and damage armature and field coil insulation.
2. Test over-running clutch action. Pinion should turn freely in over-running direction and must not slip in cranking direction. Check pinion teeth. Check spring for tension and drive collar for wear. Replace if necessary.
3. Check that brush holders are not damaged or bent and will hold brushes against commutator.
4. Check brushes. Replace if pitted or worn to one-half their original length [5/16" (8mm) or less].
5. Check fit of armature shaft in bushing of drive housing. Shaft should fit snugly. Replace bushing, if worn. Apply SAE 20 oil to bushing before re assembly. Avoid excessive lubrication.

6. Check fit of bushing in commutator end frame. If bushing is damaged or worn excessively, replace end frame assembly. Apply SAE 20 oil to bushing before reassembly. Avoid excessive lubrication.
7. Inspect armature commutator. If rough or out-of-round, turn down and undercut. Inspect points (where armature conductors join commutator bars) for good, firm connection. Burned commutator bar usually is evidence of poor connection.

Armature Tests

TEST for SHORTS

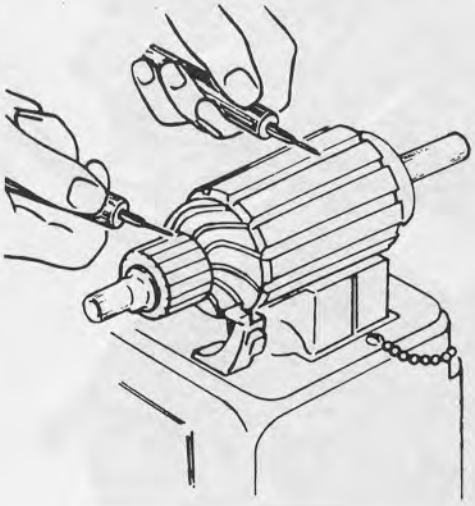
Check armature for shorts by placing on growler and holding hack saw blade over armature core while rotating armature. If saw blade vibrates, armature is shorted. After cleaning between commutator bars, recheck. If saw blade still vibrates, replace armature.



01441

TEST for GROUND

1. With continuity meter, place one lead on armature core or shaft and other lead on commutator.
2. If meter hand moves armature is grounded and must be replaced.



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Field Coil Tests

TEST for OPEN CIRCUIT

1. With continuity meter, place one lead on each end of field coils (insulated brush and field connector bar).
2. If meter does not move, field coils are open and must be replaced.

01442

TEST for GROUND

IMPORTANT: Be sure that positive brushes and leads do not contact field frame assembly during test, or false reading will result.

1. With continuity meter, place one lead on field connector bar and other lead on grounded brush.
2. If meter moves, field coils are grounded and must be replaced.

01443

Loose Electrical Connections

If open soldered connection of armature to commutator leads is found during inspection, resolder with rosin flux.

IMPORTANT: NEVER USE ACID FLUX ON ELECTRICAL CONNECTIONS.

Turning the Commutator

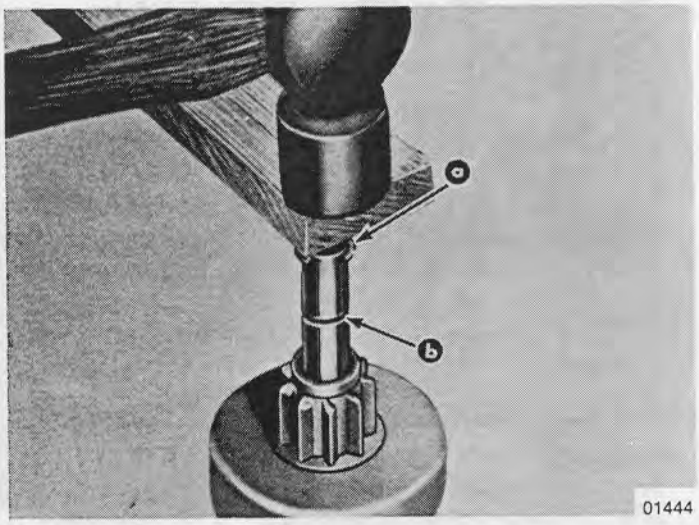
When inspection shows commutator roughness, clean as follows:

1. Turn down commutator in a lathe until thoroughly cleaned.
2. Recheck armature for shorts as outlined.

Reassembly

After all parts are thoroughly tested and inspected and worn or damaged parts replaced, reassemble starter as follows:

1. Assemble brushes and related parts to field frame as follows:
   a. Assemble brushes to brush holders. Attach ground wire to grounded brush and field lead wire to insulated brush.
   b. Assemble insulated and grounded brush holders together with "V" spring. Position as a unit and install support pin. Push holders and spring to bottom of support and rotate spring to engage center of "V" spring in slot in support.
2. Assemble over-running clutch assembly to armature shaft as follows:
   a. Lubricate drive end of armature shaft with SAE 10 oil.
   b. Slide assist spring and clutch assembly onto armature shaft with pinion outward.



a - Snap Ring
b - Groove

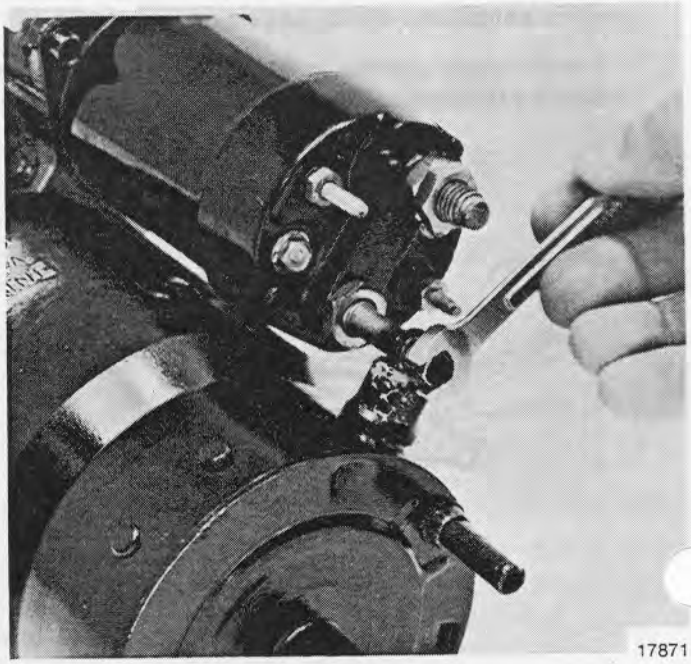
   c. Slide retainer onto shaft with cupped surface facing end of shaft (away from pinion).
   d. Drive snap ring onto shaft and slide down into groove.
   e. Assemble thrust collar on shaft with shoulde next to snap ring.
   f. Place thrust collar and retainer next to snap ring and using 2 pliers squeeze both until snap ring is forced into retainer.
3. Place 4 or 5 drops of light engine oil in drive housing bushing. Slide armature and clutch assembly into place while engaging shift lever with clutch.
4. Position field frame over armature and apply Liquid Neoprene between frame against drive housing, observing caution to prevent damage to brushes.
5. Place 4 to 5 drops of light engine oil in bushing in commutator end frame. Place brake washer and commutator end frame onto shaft.
6. Install solenoid return spring on plunger.
7. Position solenoid assembly to starter motor end frame and turn solenoid to engage flange in slot.
8. Install (and tighten securely) screws which hold solenoid assembly to end frame.
9. Secure starter motor connector strap terminal with screw and washer.

Clearances

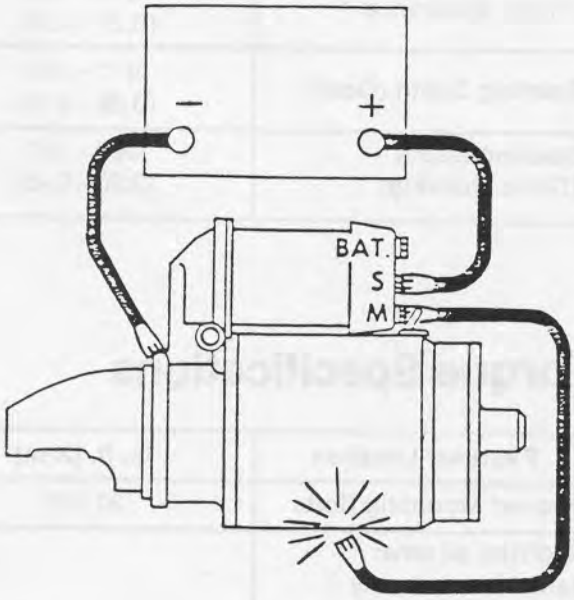
PINION CLEARANCE

Pinion clearance must be checked as follows after reassembly of motor to insure proper adjustment.

1. Disconnect motor field coil connector from solenoid motor terminal and insulate it carefully.



2. Connect 12-volt battery from solenoid switch(s) terminal to solenoid frame.
3. Momentarily touch a jumper lead from solenoid motor terminal to starter motor frame. This shifts pinion into cranking position where it will remain until battery is disconnected.



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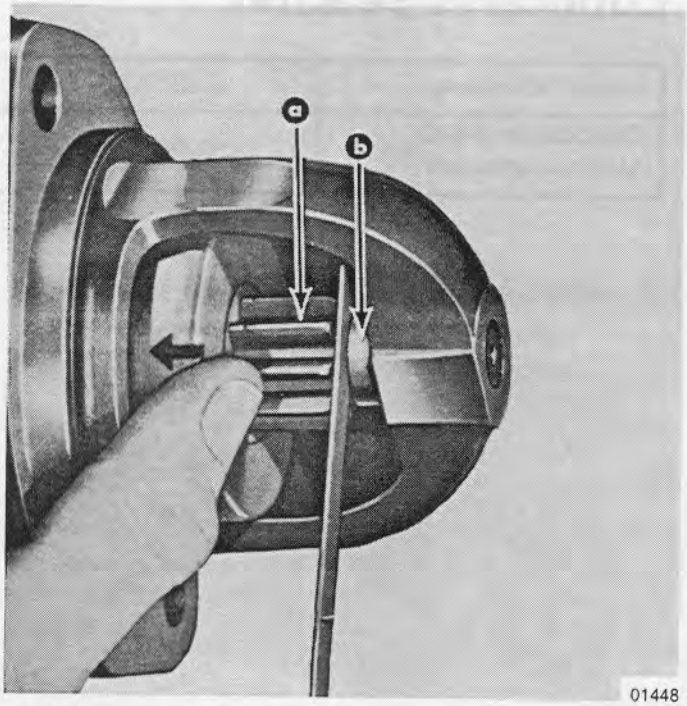
4. Push pinion back toward commutator end to eliminate slack.



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a - Pinion
b - Retainer

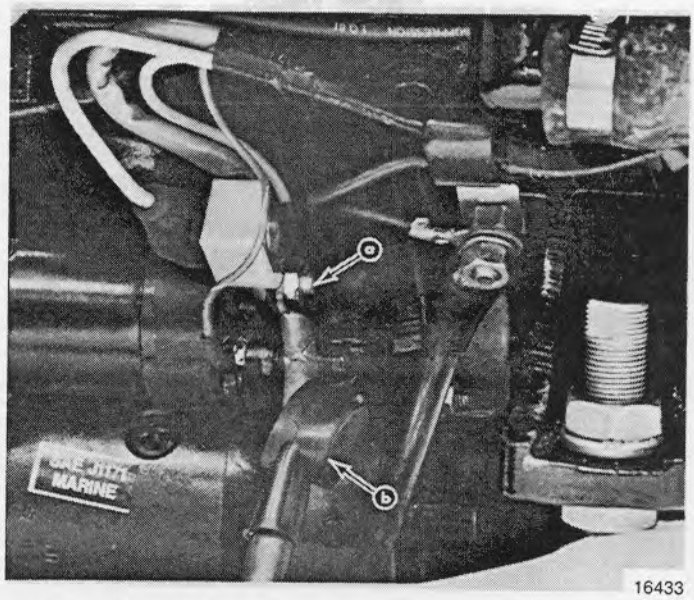
5. Measure distance between pinion and pinion retainer.
6. If clearance is not within specified limits, it may indicate excessive wear of solenoid linkage shift lever yoke buttons or improper assembly of shift lever mechanism. Check for proper assembly, and recheck gap. If still excessive, replace worn or defective parts, since no provision is made for adjusting pinion clearance.

COMMUTATOR END FRAME GAP

To keep the ignition-proof and safety requirement, the gap between the commutator end frame and field coil housing must be checked. See specifications. If the gap exceeds measurement when checked with a feeler gauge, the end frame should be checked for proper seating on the field coil housing. If properly seated and still found to have excessive gap, the end frame must be replaced.

Installation

1. Place starter motor and solenoid assembly in position and install mounting bolts.
2. Fasten wires as outlined in wiring diagram.
3. Coat solenoid terminal connections with Liquid Neoprene.
4. Place rubber boot over positive battery cable connection.



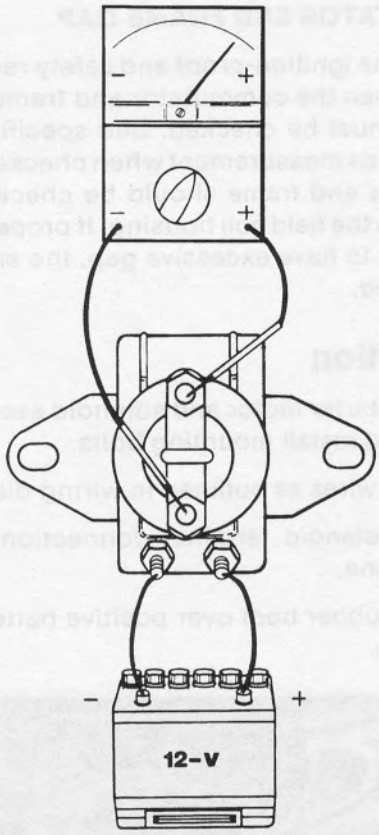
16433

a - Positive Battery Cable Connection
b - Rubber Boot

Standard Type Starter Solenoid

Testing/Replacement

1. Using continuity meter, connect test leads as shown, and connect 12-volt battery with jumper leads as shown.



2. If no meter movement is present, replace solenoid.

Permanent Magnet Gear Reduction (PMGR) Starter Motor

Specifications	in. (mm)
Pinion Clearance	.010 - .160 (0.25 - 4.06)
Bearing Depth (Gear)	.011 - .014 (0.28 - 0.38)
Bearing Depth (Drive Housing)	.009 - .017 (0.25 - 0.45)

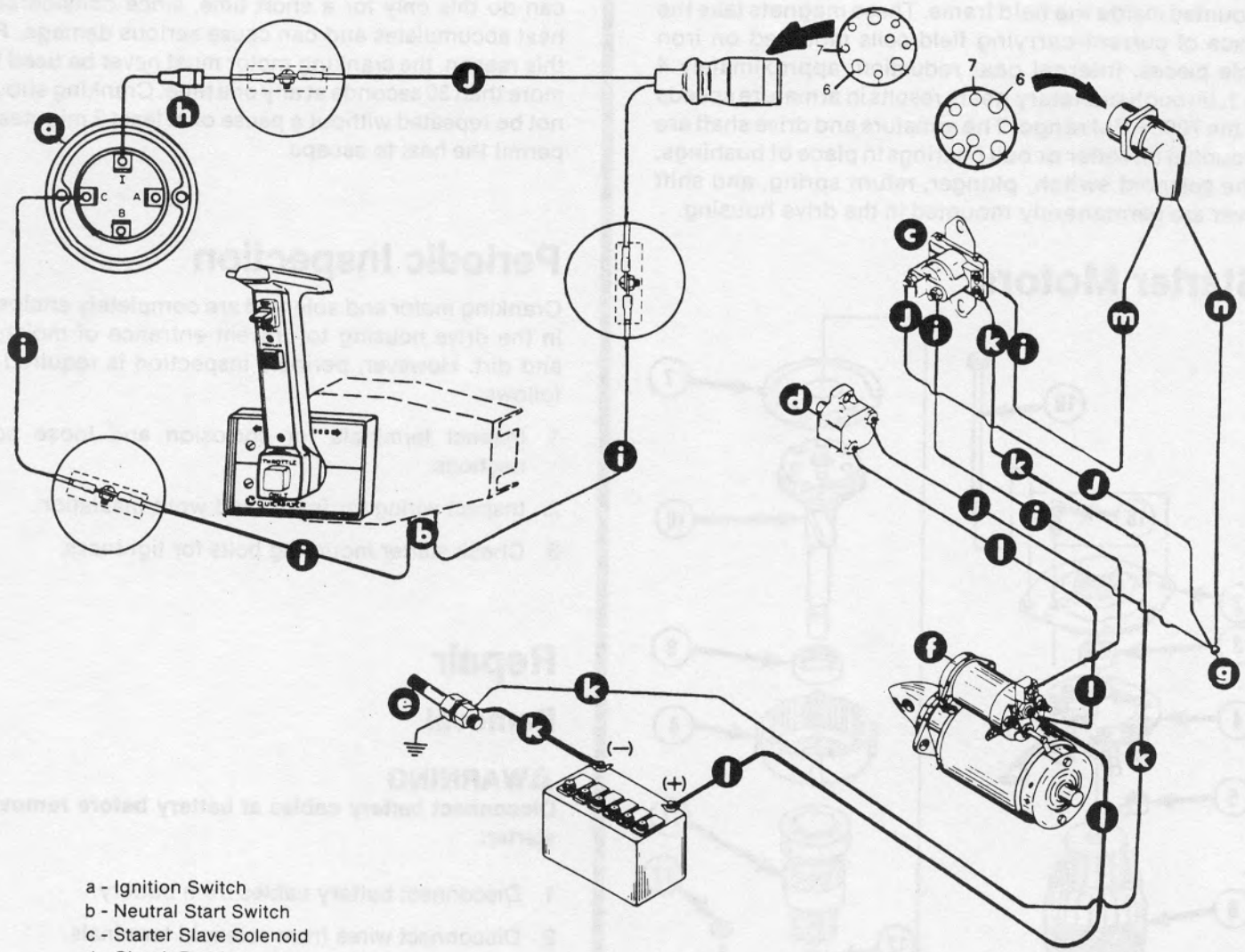
Torque Specifications

Fastener Location	lb. ft. (N·m)
Starter Mounting Bolts	30 (41)
Tighten all other fasteners securely	

Lubricants-Sealants

Liquid Neoprene	92-25711
Quicksilver 2-4-C Marine Lubricant	92-90018A12

Starting System Components

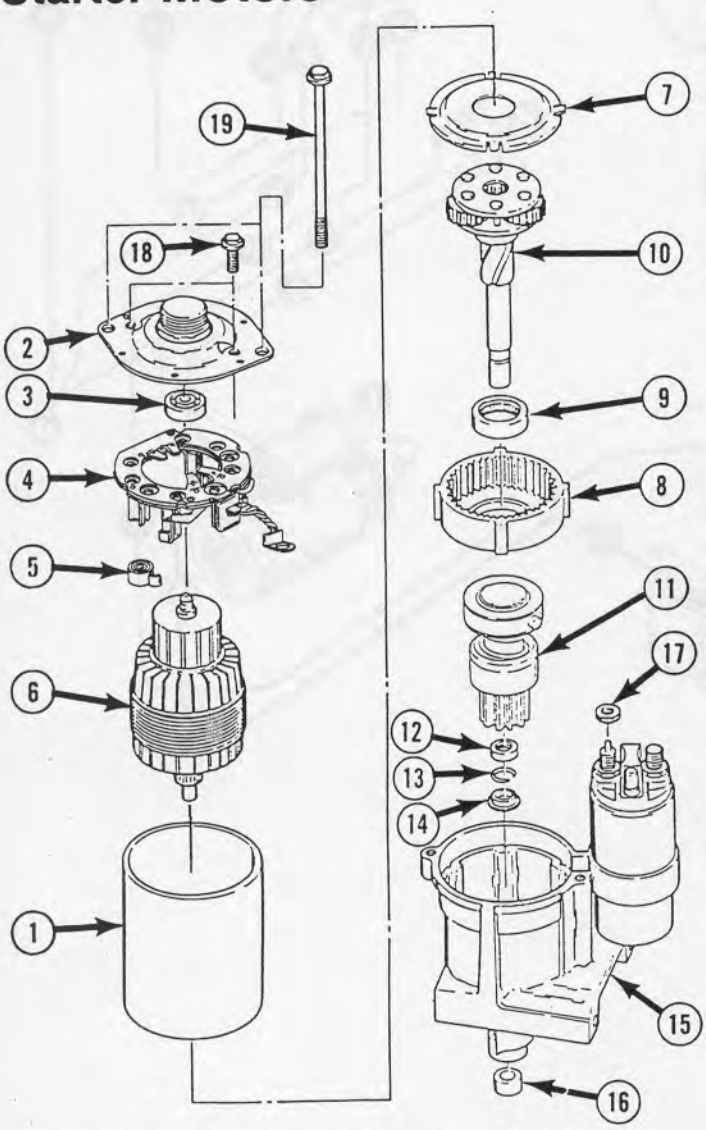


a - Ignition Switch
b - Neutral Start Switch
c - Starter Slave Solenoid
d - Circuit Breaker
e - Engine Ground Stud
f - Starter Solenoid
g - Wire Junction
h - 20 Amp Fuse
i - Yellow-Red
j - Red-Purple
k - Black
l - Red
m - Yellow-Red 7
n - Red-Purple 6

Description

The Permanent Magnet Gear Reduction (PMGR) starter motor features small permanent magnets mounted inside the field frame. These magnets take the place of current-carrying field coils mounted on iron pole pieces. Internal gear reduction, approximately 4 to 1, through planetary gears results in armature speeds in the 7000 RPM range. The armature and drive shaft are mounted on roller or ball bearings in place of bushings. The solenoid switch, plunger, return spring, and shift lever are permanently mounted in the drive housing.

Starter Motors



1 - Field Frame (With Permanent Magnets)
2 - End Frame
3 - Ball Bearing
4 - Brushes with Holder
5 - Brush Spring
6 - Armature
7 - Shield
8 - Gear
9 - Roller Bearing
10 - Planetary Gear and Shaft Assembly
11 - Drive
12 - Collar
13 - Retaining Ring
14 - Thrust Collar
15 - Drive Housing*
16 - Roller Bearing
17 - Nut
18 - Screw
19 - Thru Bolt

*Contains: Starter Solenoid, Plunger, Return Spring, and Shift Lever

Notice

The starter motor is designed to operate under great overload and produce a high horsepower for its size. It can do this only for a short time, since considerable heat accumulates and can cause serious damage. For this reason, the cranking motor must never be used for more than 30 seconds at any one time. Cranking should not be repeated without a pause of at least 2 minutes to permit the heat to escape.

Periodic Inspection

Cranking motor and solenoid are completely enclosed in the drive housing to prevent entrance of moisture and dirt. However, periodic inspection is required as follows:

1. Inspect terminals for corrosion and loose connections.
2. Inspect wiring for frayed and worn insulation.
3. Check starter mounting bolts for tightness.

Repair

Removal

⚠WARNING
Disconnect battery cables at battery before removing starter.

1. Disconnect battery cables from battery.
2. Disconnect wires from solenoid terminals.

IMPORTANT: Some starter motors may use a special mounting shim for gaining flywheel clearance. Do not lose this shim, it will be needed when remounting starter on engine block.

3. Remove starter mounting bolts.
4. Pull starter assembly away from flywheel and remove from engine.

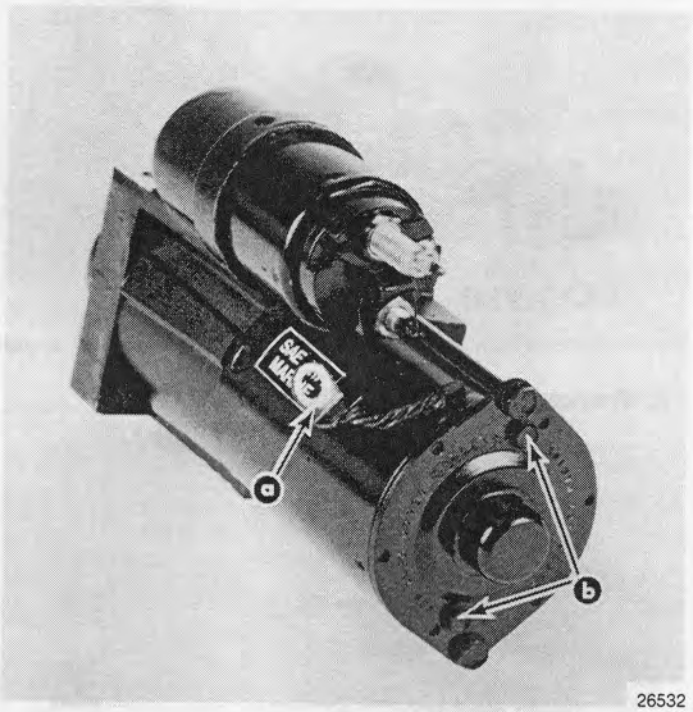
Solenoid Switch

The solenoid switch, along with plunger, return spring, and shift lever, are completely sealed and permanently mounted in the drive housing. If solenoid is defective, entire drive housing must be replaced.

Starter Motor

Disassembly

1. Remove brush lead (a) from solenoid and screws (b) from end frame.



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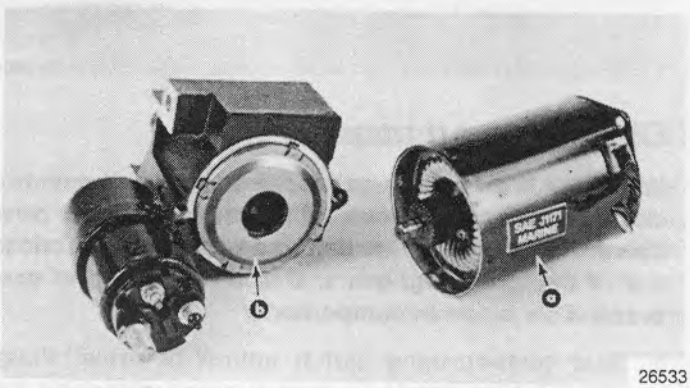
2. Remove thru bolts and separate field frame with armature (a) from drive housing (b).



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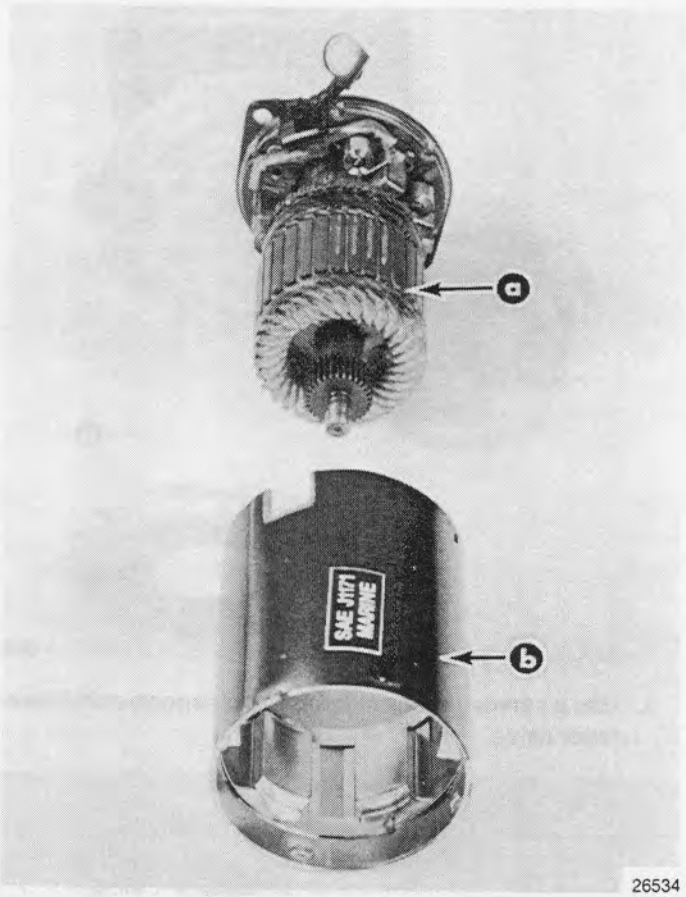
3. Pull armature (a) out of field frame (b).

NOTE: Permanent magnets inside field frame will be holding armature in place.



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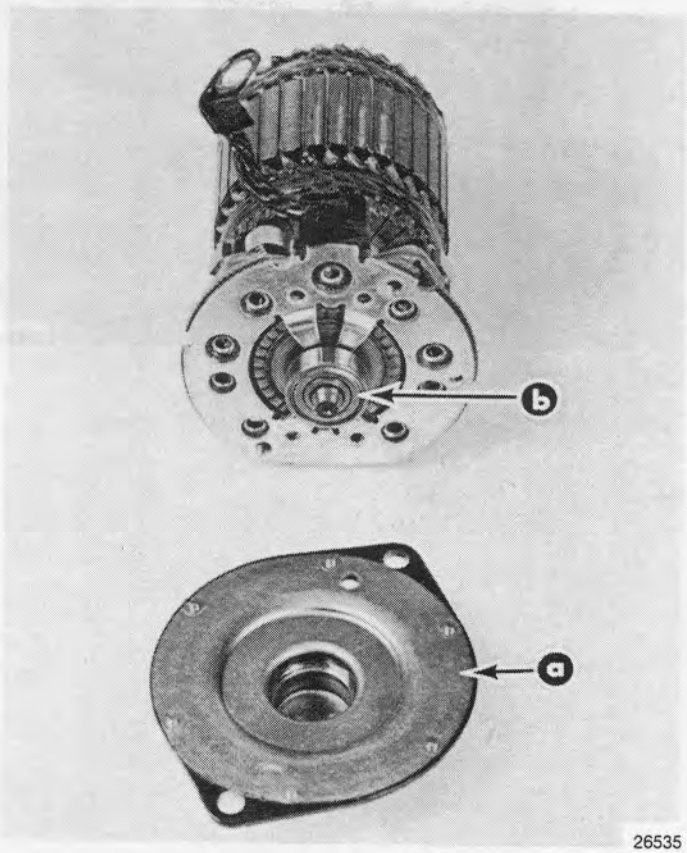
4. Pull end frame (a) off bearing (b).



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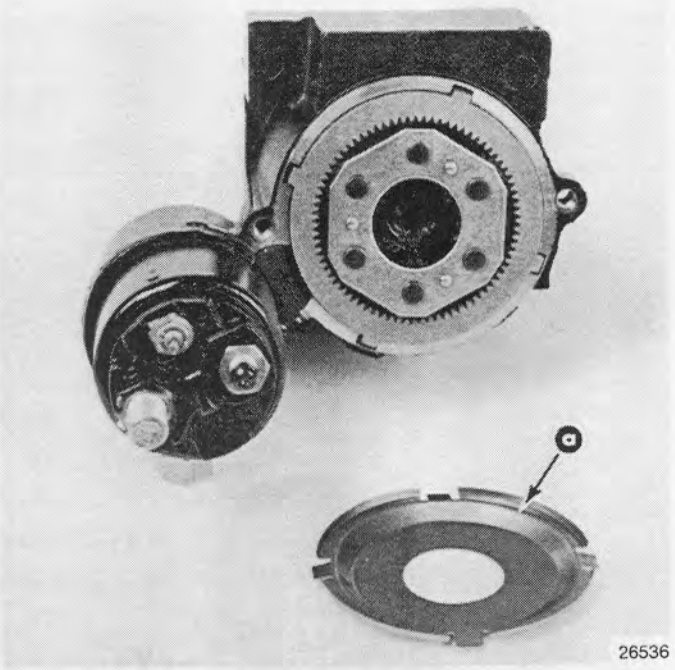
5. Remove shield (a).



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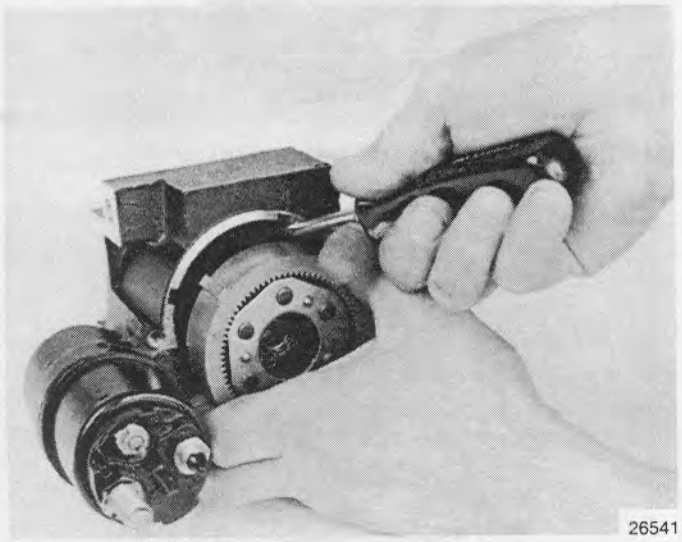
6. Use a screwdriver, as shown, to disengage shift lever from drive.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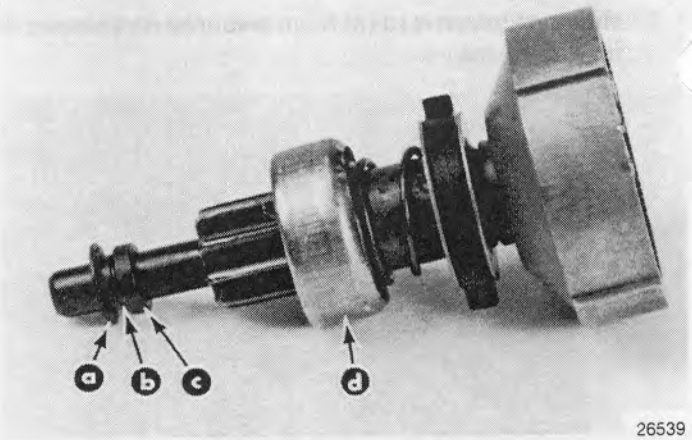
7. Remove thrust collar (a), retaining ring (b) and collar (c). Remove drive (d).



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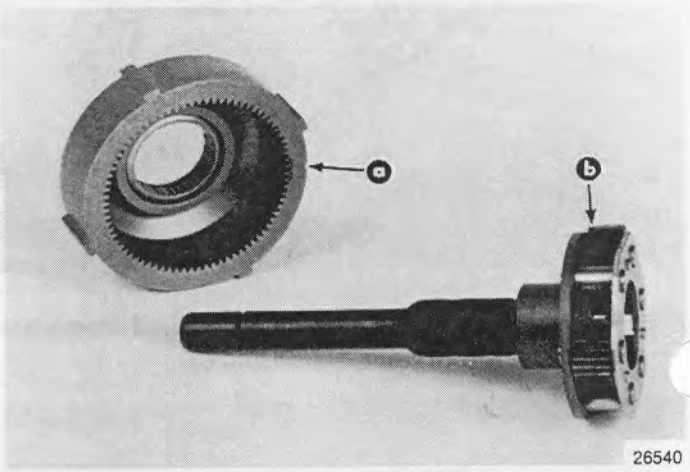
8. Remove gear (a) from shaft assembly (b).



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Cleaning and Inspection

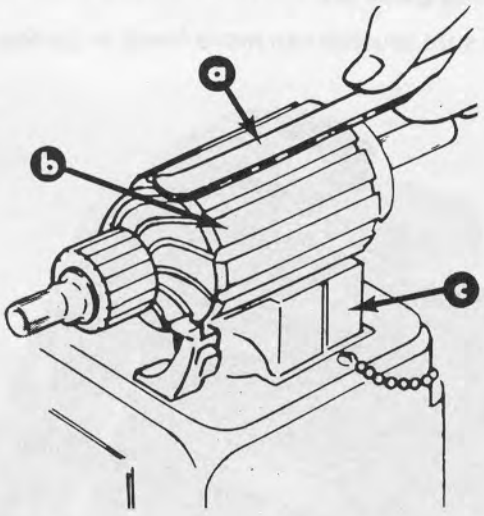
IMPORTANT: Do not use grease dissolving solvents to clean electrical components, planetary gears, or drive. Solvent will damage insulation and wash the lubricant out of the drive and gears. Use clean rags and compressed air to clean components.

1. Test over-running clutch action of drive. Pinion should turn freely in over-running direction and must not slip in cranking direction. Check pinion teeth. Check spring for tension and drive collar for wear. Replace if necessary.
2. Check that brush holders are not damaged or bent and hold brushes against commutator. Check brushes for wear; refer to "Brushes and Brush Holder."
3. Inspect armature commutator. If badly grooved or out-of-round, turn down and undercut commutator.
4. Inspect all roller bearing surfaces for wear. Check that bearings roll freely. If any roughness is fe replace bearings.
5. Inspect planetary gear assembly. Gears must mesh easily and roll freely with no binding.

Armature Tests

TEST FOR SHORTS

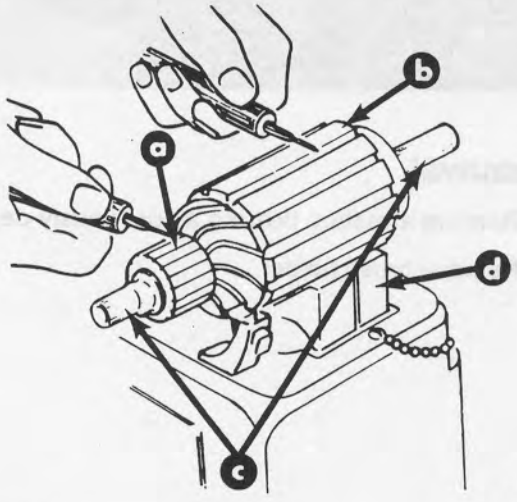
Check armature for shorts by placing on growler and holding hack saw blade over armature core while rotating armature. If saw blade vibrates, armature is shorted. After cleaning between commutator bars, recheck. If saw blade still vibrates, replace armature.



a - Hacksaw Blade
b - Armature Core
c - Growler

TEST FOR GROUND

1. With continuity meter, place one lead on armature core or shaft and other lead on commutator.
2. If meter hand moves to right, armature is grounded and must be replaced.

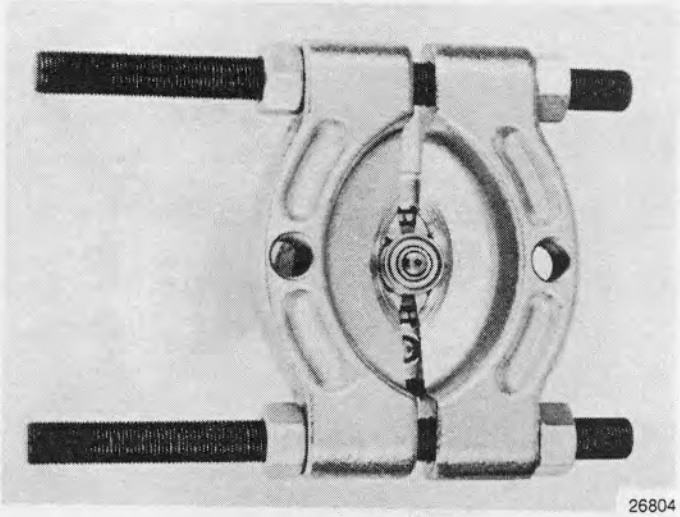


a - Commutator
b - Armature Core
c - Shaft
d - Growler

Armature Bearing (Commutator End)

Removal

Use a universal puller plate, as shown, to remove bearing.



Installation

IMPORTANT: Brush holder must be installed on armature before installing armature bearing.

Using the correct size driver, press inner bearing race in, until it contacts shoulder of armature shaft.

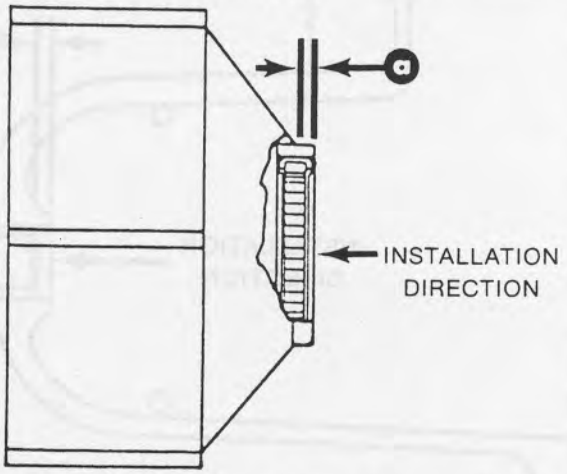
Gear Bearing

Removal

Using the correct size driver, press bearing out of gear.

Installation

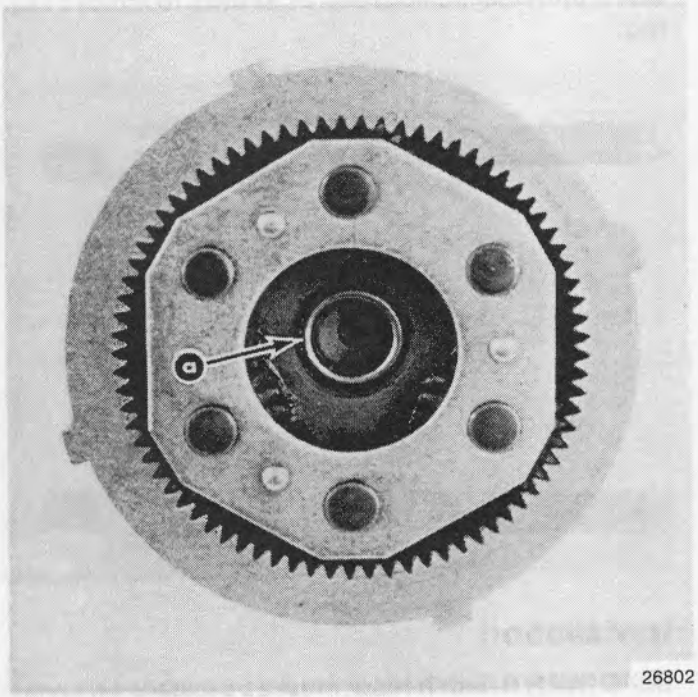
1. Using the correct size driver, press bearing into gear, from direction shown, to a depth of .011 - .014 in. (0.28 - 0.38mm), (a).



2. Lubricate bearing and gear teeth with a small amount of Quicksilver 2-4-C Marine Lubricant.

SHAFT ASSEMBLY BEARING

IMPORTANT: Roller bearing (a) is not replaceable. If bearing is defective, replace entire shaft assembly. Apply Quicksilver 2-4-C Marine Lubricant to bearing before starter reassembly.



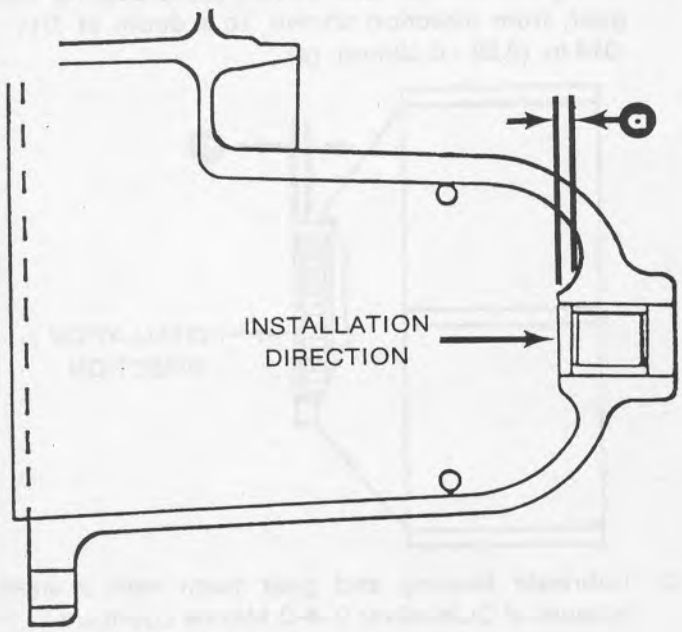
Drive End Housing Bearing

Removal

Using the correct size driver, press bearing out of housing.

Installation

1. Using the correct size driver, press bearing into housing, from direction shown, to a depth of .009 - .017 in. (0.25-0.45mm), (a).



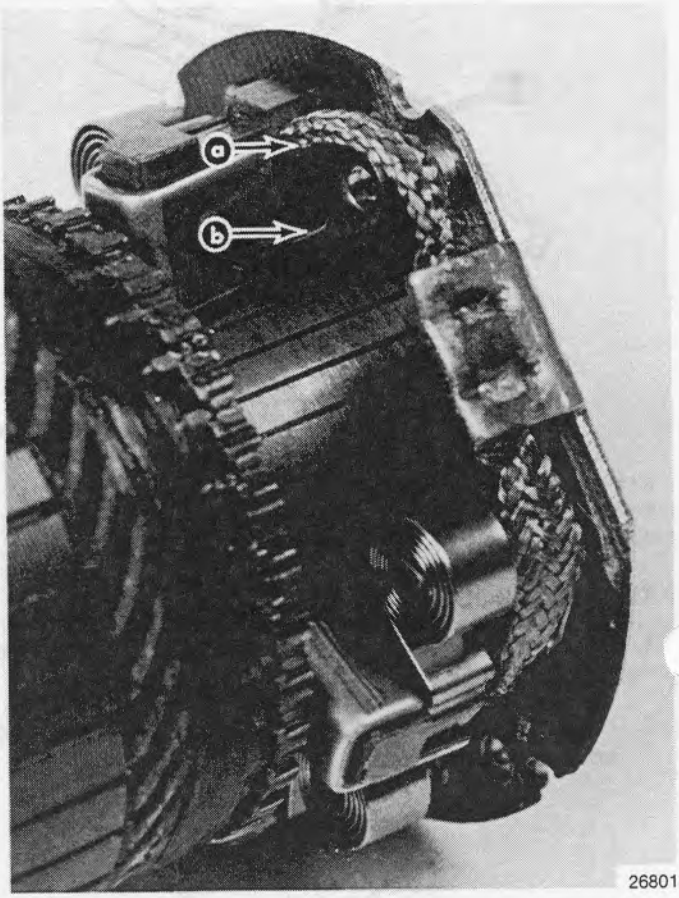
2. Lubricate bearing with a small amount of Quicksilver 2-4-C Marine Lubricant.

Brushes and Brush Holder

Inspection

Replace brushes and holder when brush leads (a) are touching guide (b).

Make sure brushes can move freely in guides.

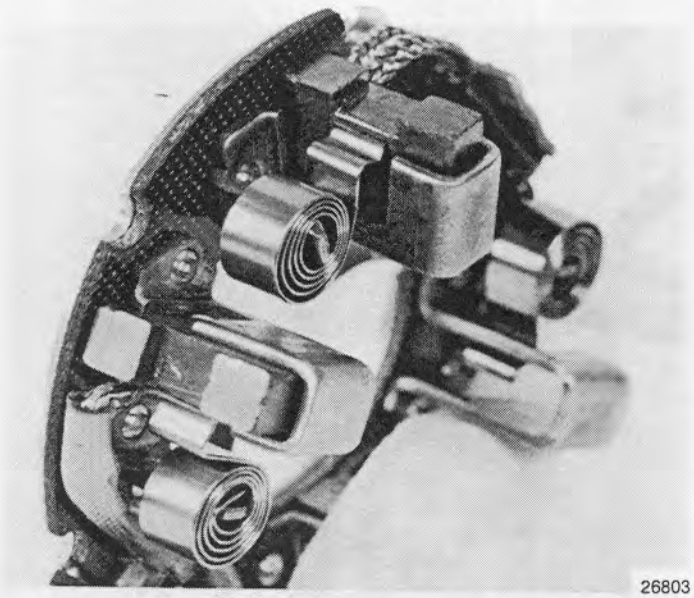


Removal

1. Remove armature bearing as previously described.
2. Remove brush holder.

Installation

1. Push each brush up into its guide to allow spring to hold it in place, as shown.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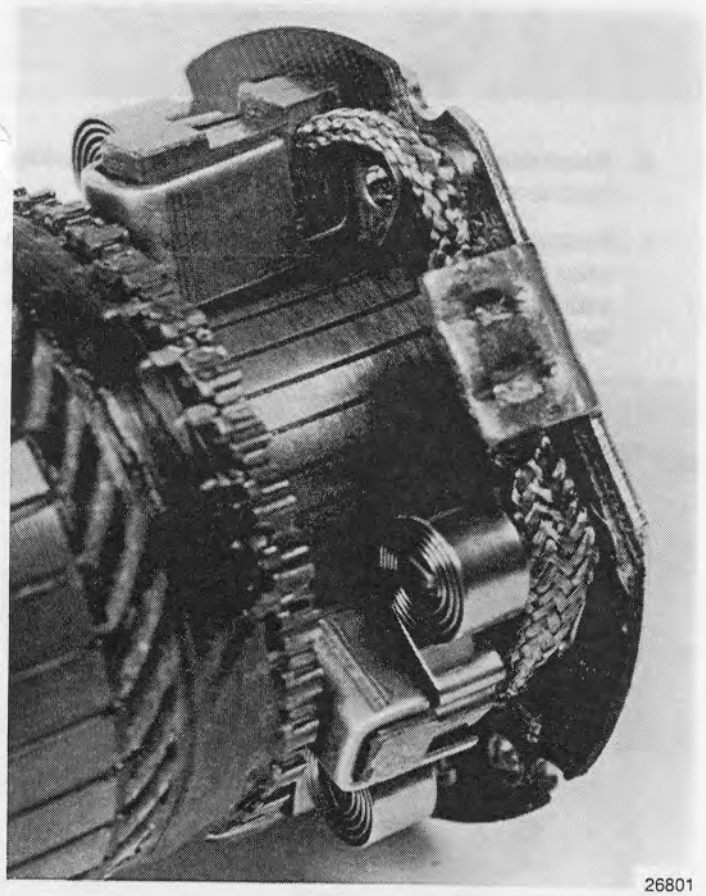
2. Place brush holder on armature and push brushes down against commutator, as shown.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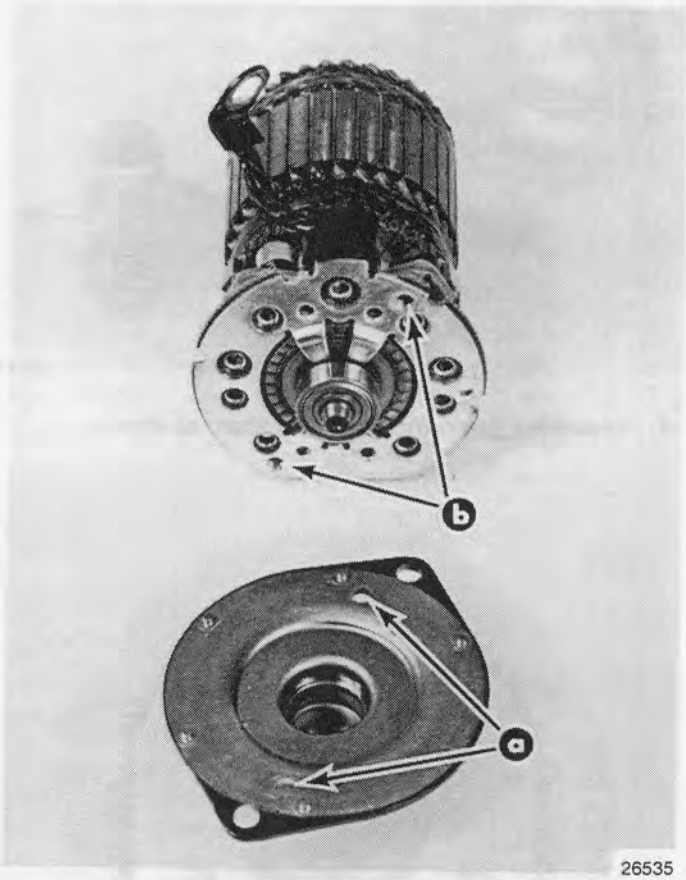
3. Install armature bearing as previously described.

Reassembly

1. Install end frame on brush holder. Align holes (a) of end frame with holes (b) of brush holder. Tighten screws securely.



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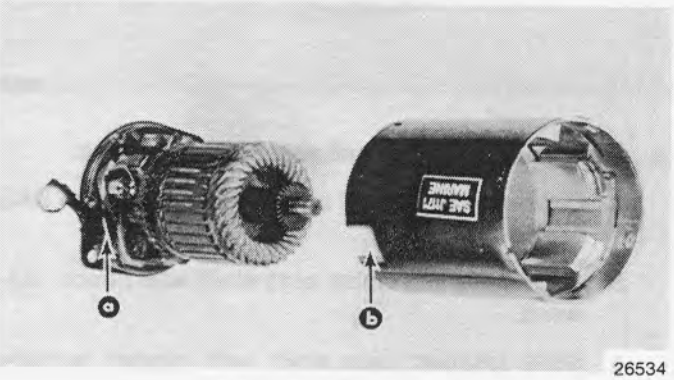
2. Insert armature into field frame. Align brush holder lead (a) with notch (b) in field frame.

NOTE: Permanent magnets in field frame will pull armature in place.



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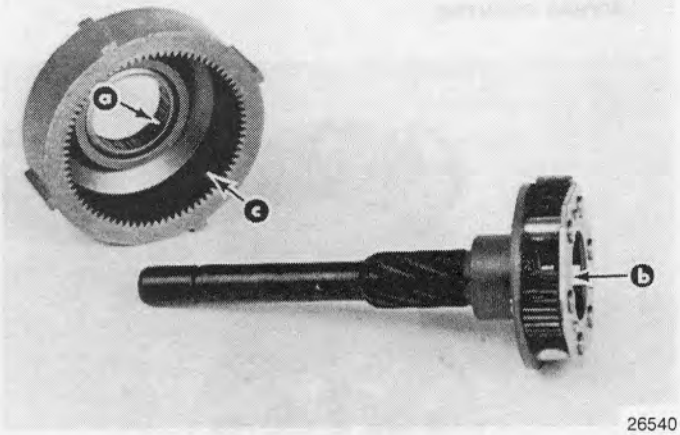
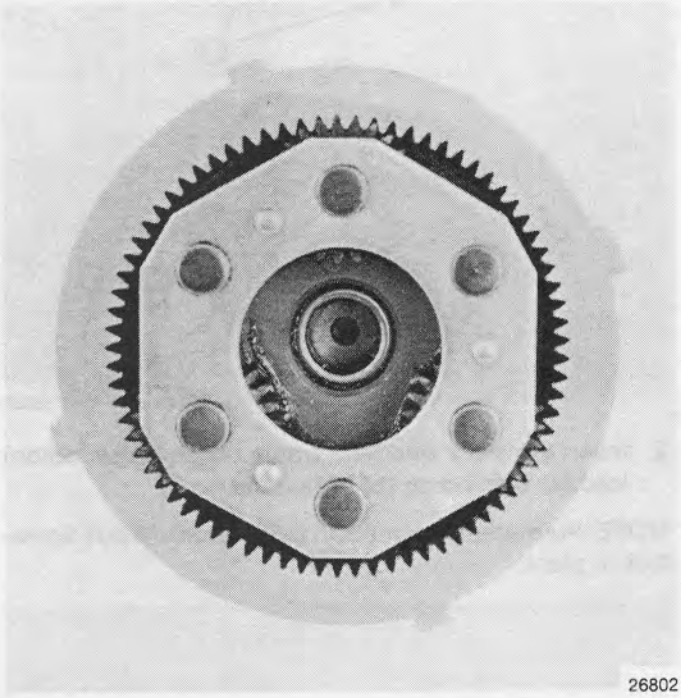
3. Coat roller bearings (a) and (b), and gear (c) with a small amount of Quicksilver 2-4-C Marine Lubricant.



26540

4. Assemble gear and shaft together, as shown.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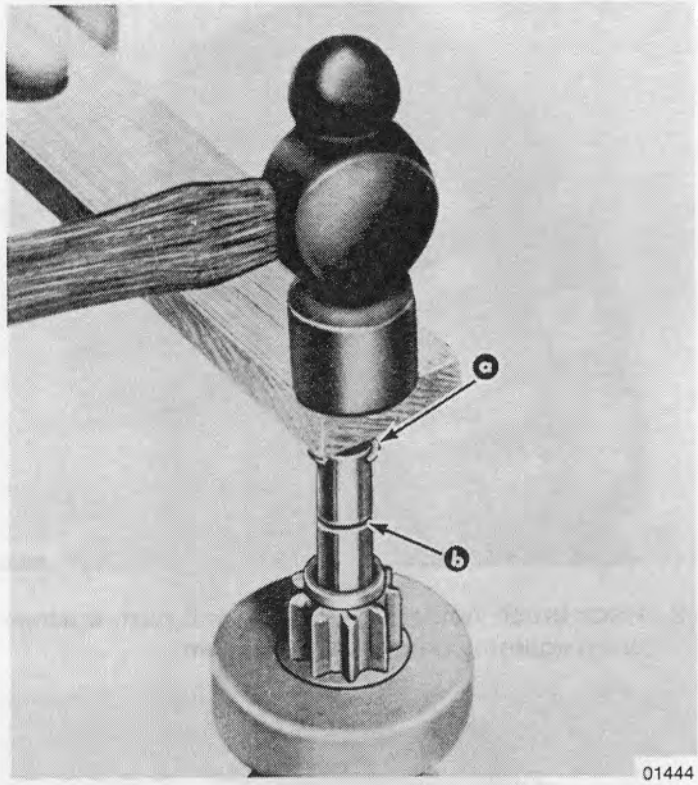
5. Assemble drive on shaft assembly as follows:
   a. Lubricate drive end of shaft assembly with SAE 10W oil.
   b. Slide drive assembly onto shaft with pinion outward.
   c. Slide retainer onto shaft with cupped surface facing end of shaft (away from pinion).
   d. Position snap ring (a) on upper end of shaft and hold in place with block of wood. Strike wood block with hammer, thus forcing snap ring over end of shaft. Slide snap ring down into groove (b).



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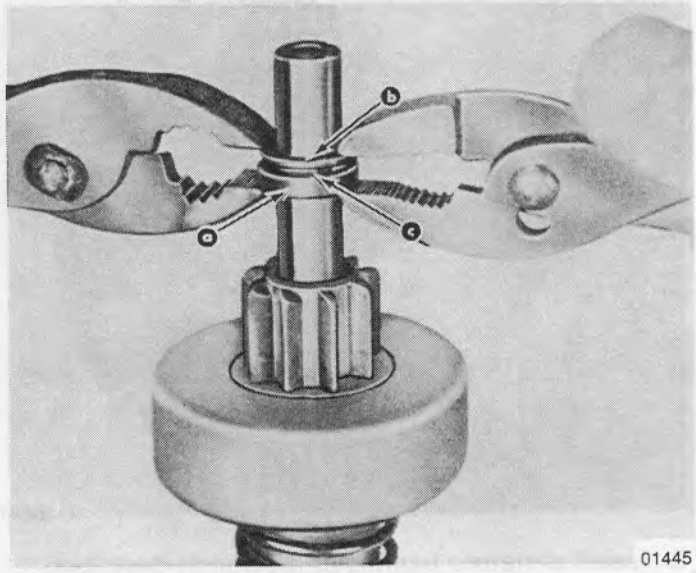
   e. Assemble thrust collar on shaft with shoulder next to snap ring.
   f. Position retainer (a) and thrust collar (b) next to snap ring (c). Then, using 2 pliers, grip retainer and thrust collar and squeeze until snap ring is forced into retainer.



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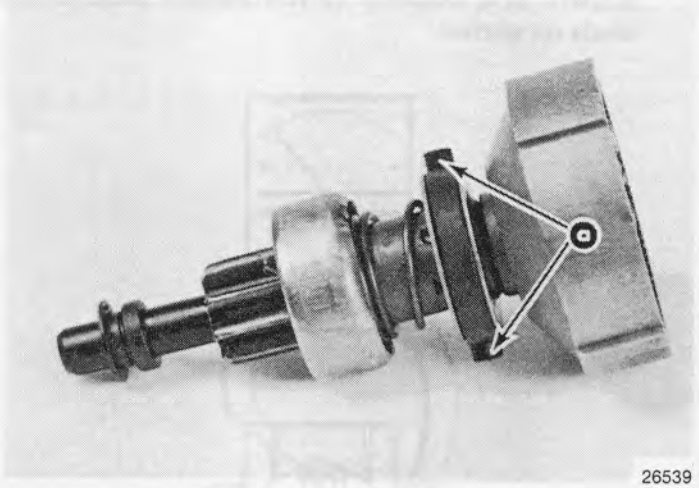
6. Apply a thin coating of Quicksilver 2-4-C Marine Lubricant to roller bearing in drive housing.
7. Insert shaft and drive assembly into drive housing. Pins of drive (a) must be snapped into holes of shift lever (b). Thrust collar must be in place before shaft is inserted in housing roller bearing.



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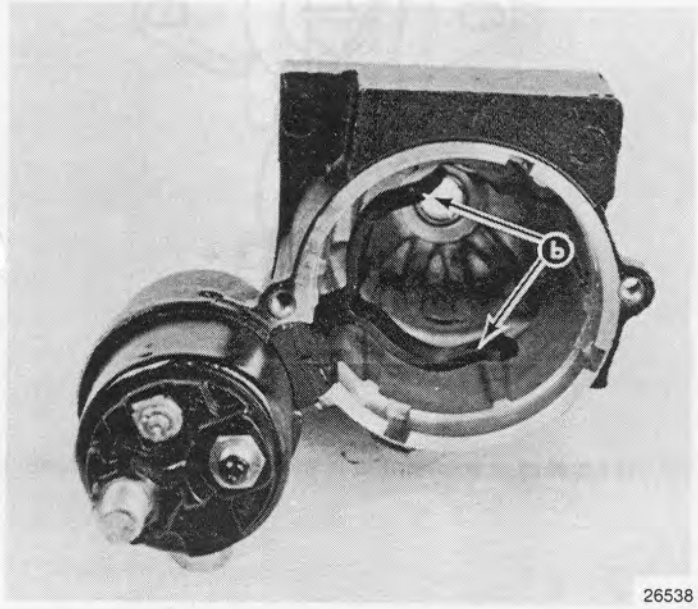

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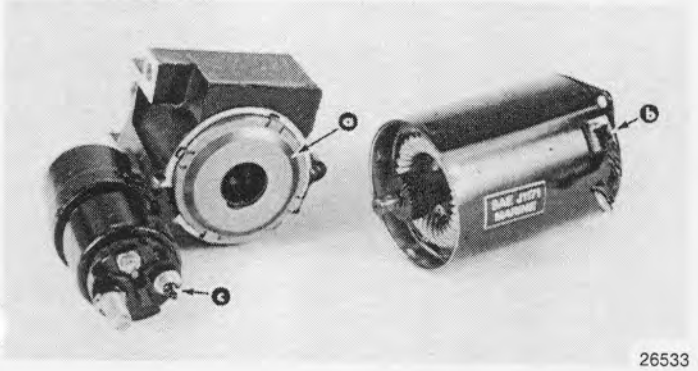
8. Install shield (a). Align brush lead (b) and solenoid terminal (c) when inserting armature into planetary gears.



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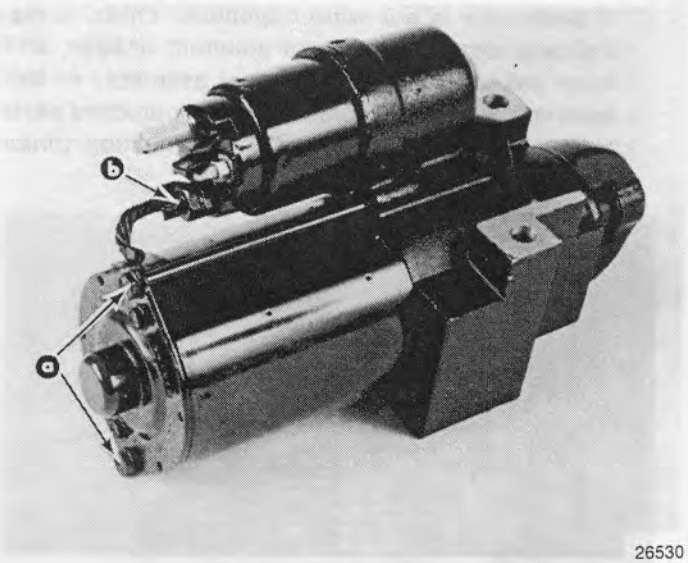
9. Install thru bolts (a) and brush lead (b). Tighten fasteners securely.

IMPORTANT: Do not overtighten thru bolts. Overtightening will bend end frame.



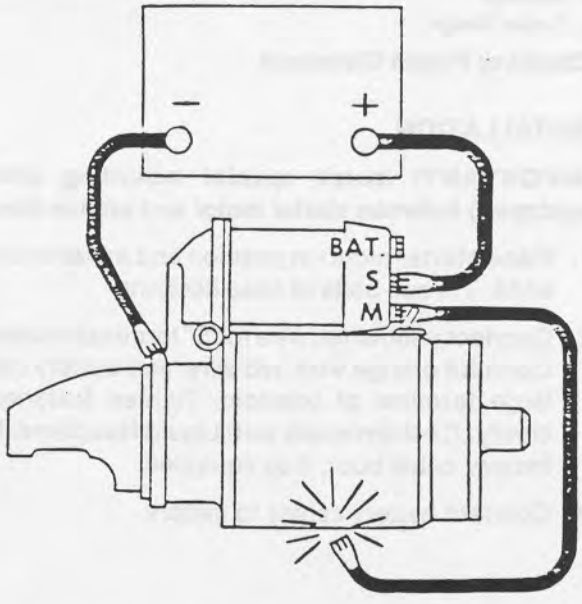
26530

Clearances

PINION CLEARANCE

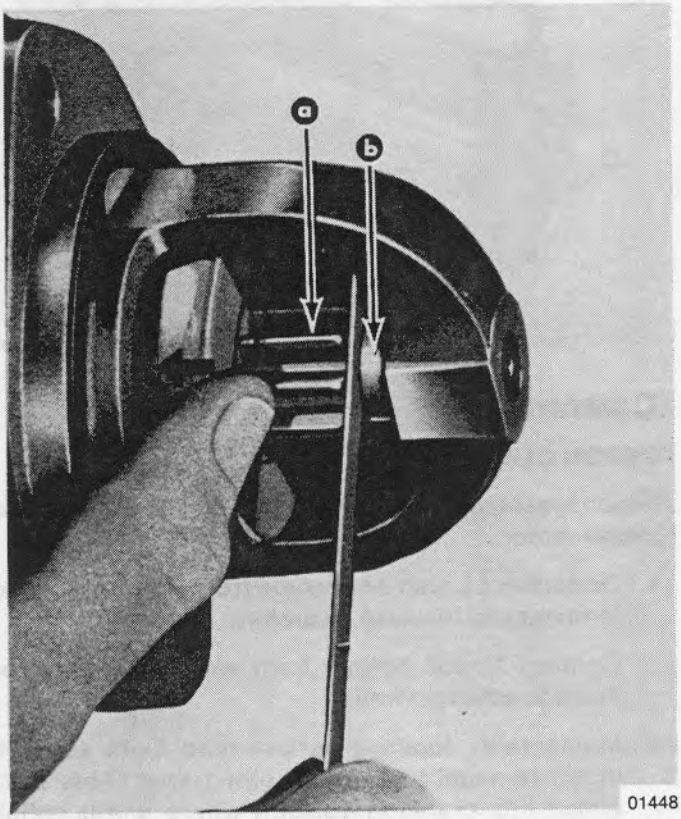
Pinion clearance must be checked after reassembly of starter motor.

1. Disconnect brush connector from solenoid motor terminal and insulate it carefully.
2. Connect 12-volt battery from solenoid switch terminal to solenoid frame.
3. Momentarily touch a jumper lead from solenoid motor terminal to starter motor frame. This shifts pinion into cranking position where it will remain until battery is disconnected.



Circuit for Checking Pinion Clearance 01447

4. Push pinion back toward commutator end to eliminate slack.
5. Measure distance between pinion and pinion retainer.
6. If clearance is not within specified limits, it may indicate excessive wear of solenoid linkage, shift lever yoke buttons, or improper assembly of shift lever mechanism. Replace worn or defective parts, since no provision is made for adjusting pinion clearance.



a - Pinion
b - Retainer
c - Feeler Gauge

Checking Pinion Clearance

INSTALLATION

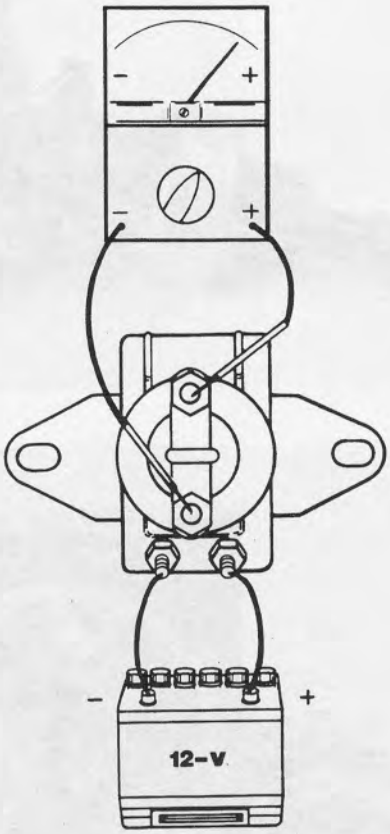
IMPORTANT: Install special mounting shim (if equipped) between starter motor and engine block.

1. Place starter motor in position and install mounting bolts. Torque bolts to specifications.
2. Connect yellow/red wire to "S" terminal of solenoid. Connect orange wire, red wire, and battery cable to large terminal of solenoid. Tighten fasteners securely. Coat terminals with Liquid Neoprene. Install battery cable boot, if so equipped.
3. Connect battery cables to battery.

Standard Starter Slave Solenoid

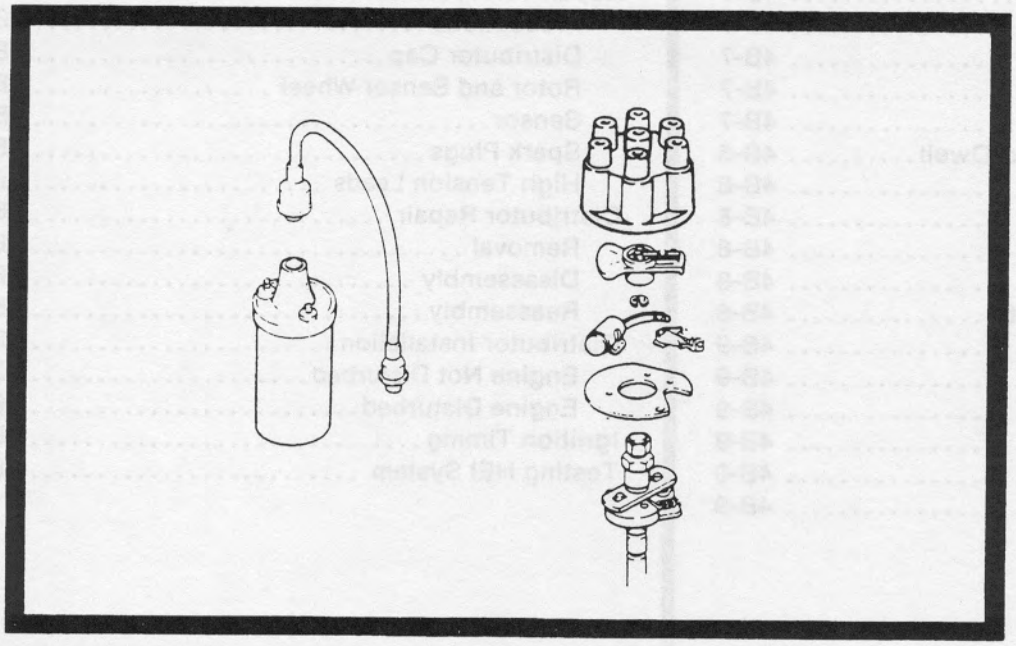
Testing/Replacement

1. Using continuity meter, connect test leads as shown, and connect 12-volt battery with jumper leads as shown.



2. If no meter movement is present, replace solenoid.

ELECTRICAL SYSTEMS



4

B

IGNITION SYSTEM

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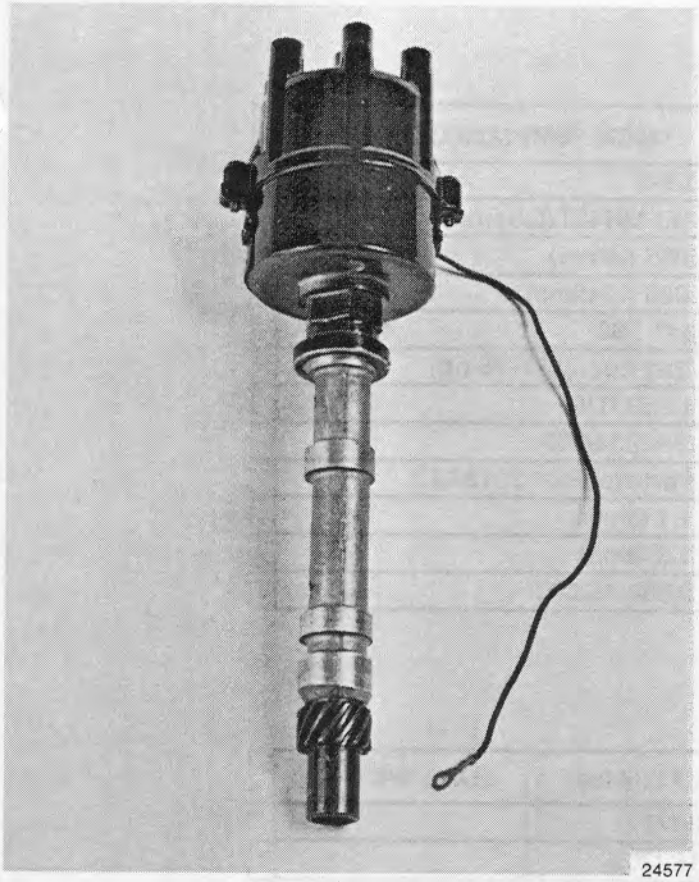
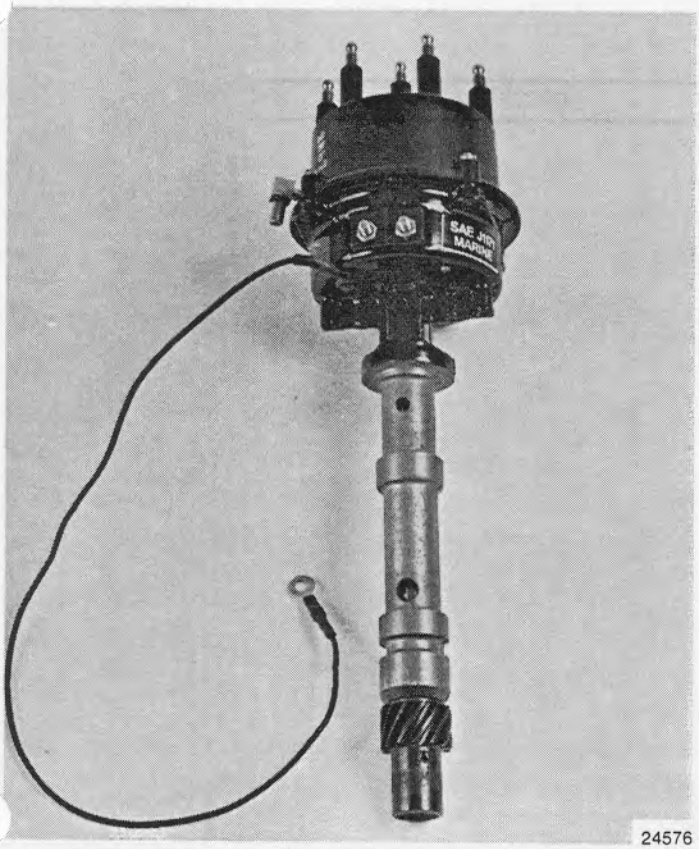
Identification



Breaker Point Distributor



Thunderbolt (HEI) Distributor

⚠WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Precautions

⚠WARNING

When testing or servicing the ignition system, it is of extreme importance that the following precautions be observed, as high voltage is present. DO NOT touch or disconnect any ignition system parts while engine is running, key switch is on, or while battery cables are connected. Follow test procedures carefully.

Failure to comply with the following may result in damage to the ignition system.

A Do not reverse battery cable connections at the battery. System is negative (-) ground.
B Do not "spark" battery terminals with battery cable connectors to check polarity.
C Do not disconnect battery cables while engine is running.
D Follow service procedures in the order listed.

Breaker Point Ignition

Specifications

ENGINE MODEL	MCM 185R (229 C.I.D.)
Resistor Wire (Ohms)	1.8-2
Spark Plug Type	AC-MR43T/Champion RV8C
Spark Plug Gap	.035 (.9mm)
Point Gap	.020 (.0-.5mm)
Point Dwell	34° - 38°
Point Spring Tension	20-27 oz. (567-765 g)
Timing	12° BTDC
Condenser	.18-.25 MFD.
Coil	Part Number 32193A2
Coil Primary Resistance (Min.)	1.1 Ohms
Coil Primary Resistance (Max.)	1.5 Ohms
Coil Secondary Resistance	9,500-15,000

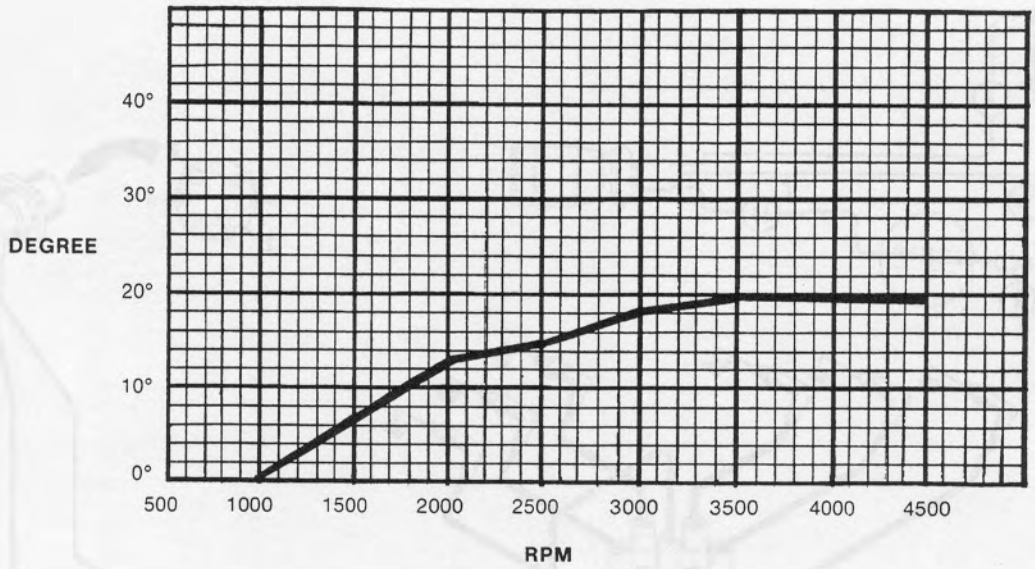
Torque Specifications

FASTENER	LBS. FT. (N.m)	LBS. IN. (N.m)
Distributor Hold Down	20 (27)	
Spark Plug	15 (20)	

Lubricants/Sealants

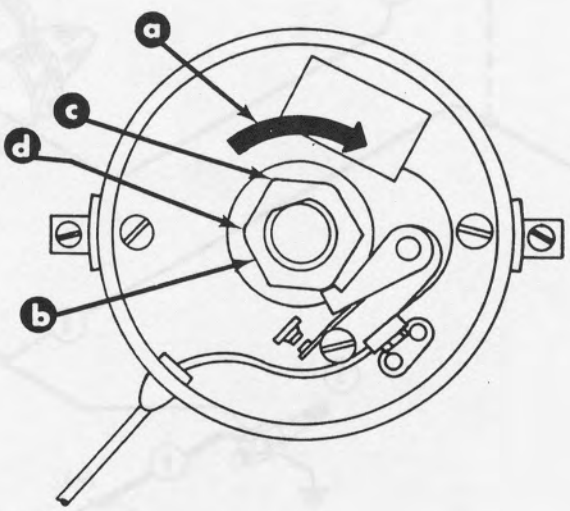
Liquid Neoprene	90-25711-2

Distributor Advance Curve

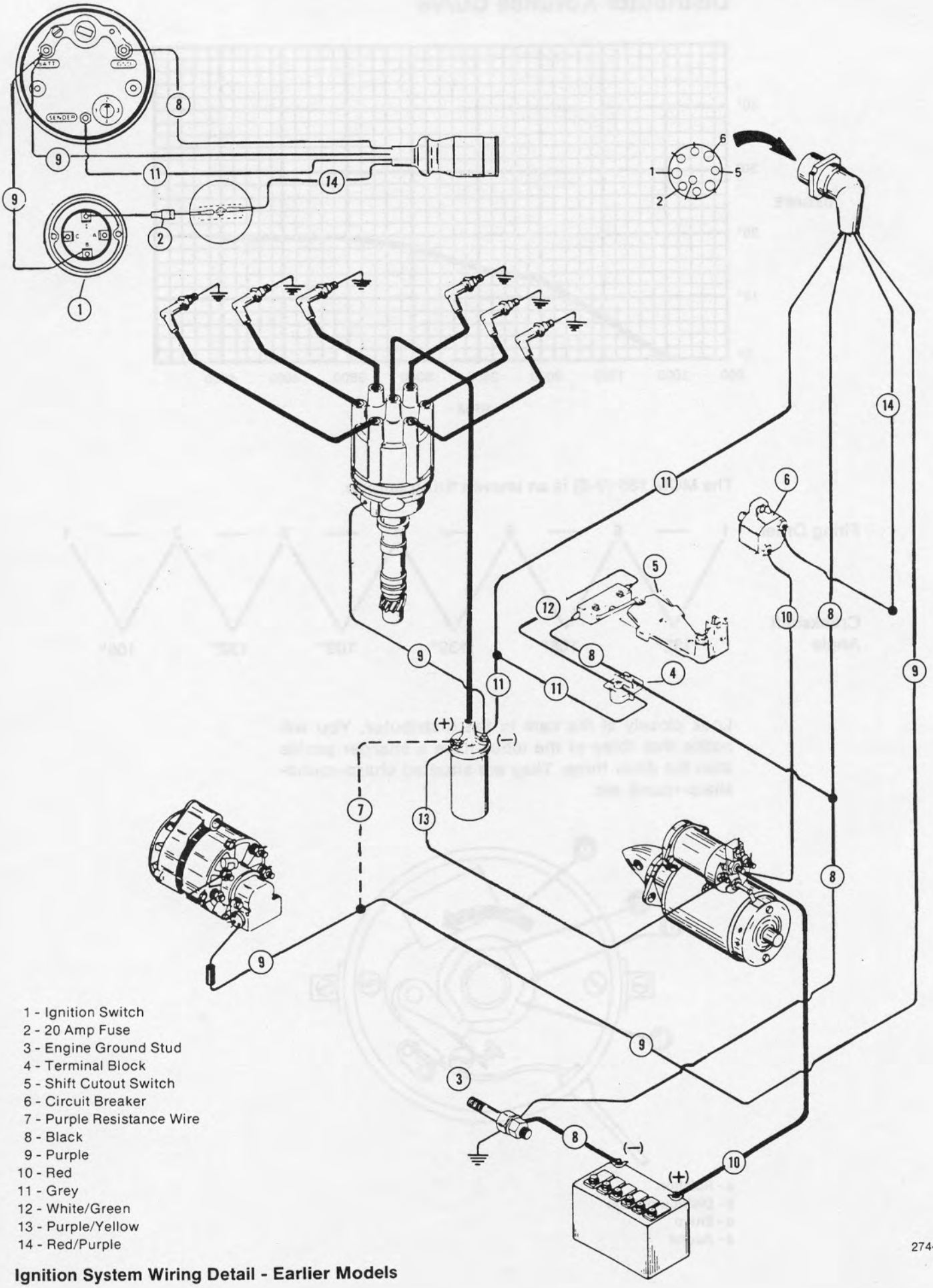


The MCM 185 (V-6) is an uneven firing engine.

Look closely at the cam in the distributor. You will notice that three of the lobes have a sharper profile than the other three. They are situated sharp-round-sharp-round, etc.



a - Rotation
b - Distributor Cam
c - Sharp
d - Round



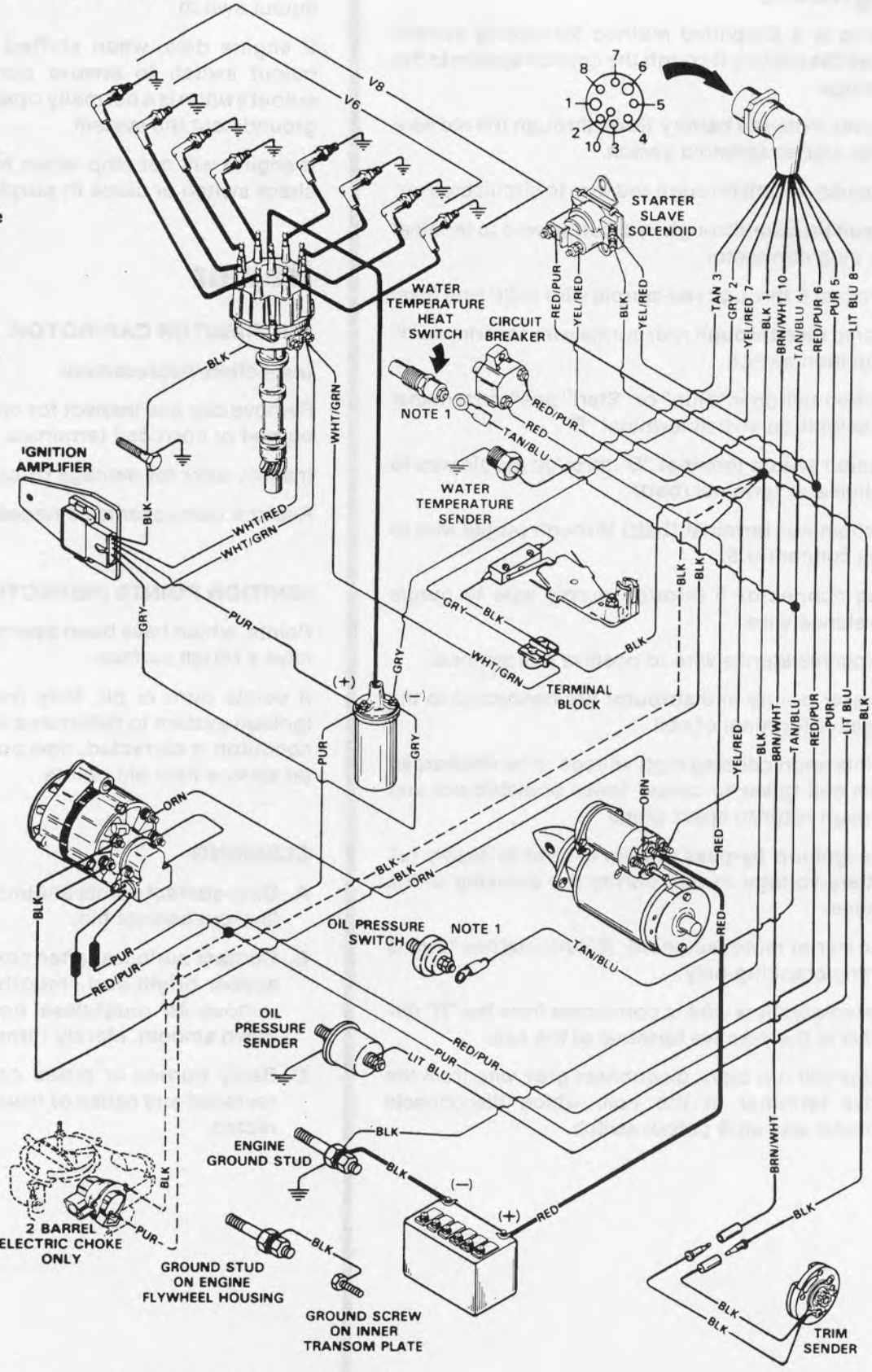
1 - Ignition Switch
2 - 20 Amp Fuse
3 - Engine Ground Stud
4 - Terminal Block
5 - Shift Cutout Switch
6 - Circuit Breaker
7 - Purple Resistance Wire
8 - Black
9 - Purple
10 - Red
11 - Grey
12 - White/Green
13 - Purple/Yellow
14 - Red/Purple

274-H

Ignition System Wiring Detail - Earlier Models

ENGINE V6/V8 — LATER MODELS

BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark



NOTE 1: OPTIONAL AUDIO WARNING SYSTEM CIRCUIT

Diagnosis

Following is a simplified method for tracing current flow from the battery through the ignition system to the spark plugs.

1. 12 volts from the battery flows through the red wire to the starter solenoid switch.
2. Solenoid switch through red wire to circuit breaker.
3. Circuit breaker through red/purple wire to terminal 6 in plug connector.
4. Terminal 6 through red/purple wire to 20 amp fuse.
5. 20 amp fuse through red/purple wire to terminal "I" of ignition switch.
6. Ignition switch in "Run" or "Start" position terminal "I" to ignition switch terminal "B".
7. Ignition switch terminal "B" through purple wire to tachometer terminal (batt).
8. Tachometer terminal (batt) through purple wire to plug connector 5.
9. Plug connector 5 through purple wire to purple resistance wire.
10. Purple resistance wire to positive coil terminal.
11. Breaker points in distributor are connected to the negative terminal of coil.
12. Points open causing high voltage to be discharged from coil tower to center tower of distributor and through rotor to spark plugs.
13. The ignition by-pass system is used to supply full battery voltage to coil during the cranking of the engine.
14. The starter motor solenoid "R" terminal has 12 volts during cranking only.
15. A purple/yellow wire is connected from the "R" terminal to the positive terminal of the coil.

If engine will not start, disconnect grey wire from the negative terminal of the coil, which disconnects tachometer and shift cutout switch.

If engine runs, the problem is in the tachometer or shift cutout switch.

If engine dies, when shifted into gear, check shift cutout switch to ensure correct adjustment. Shift cutout switch is a normally open type and when closed, grounds out the system.

If engine will not stop when turned off at key switch, check switch or diode in purple lead at alternator.

Repair

DISTRIBUTOR CAP/ROTOR

Inspection/Replacement

Remove cap and inspect for cracks, carbon tracks and burned or corroded terminals.

Inspect rotor for damage or burned contacts.

Replace components as necessary.

IGNITION POINTS INSPECTION

Points, which have been operated for a period of time, have a rough surface.

If points burn or pit, they must be replaced. Check ignition system to determine cause of trouble. Unless condition is corrected, new points will provide no better service than old points.

CLEANING

A. Dirty contact points should be dressed with a clean, fine-cut contact file.

B. Contact surfaces, after considerable use, may not appear bright and smooth, but do not attempt to remove all roughness nor dress point surfaces down smooth. Merely remove scale or dirt.

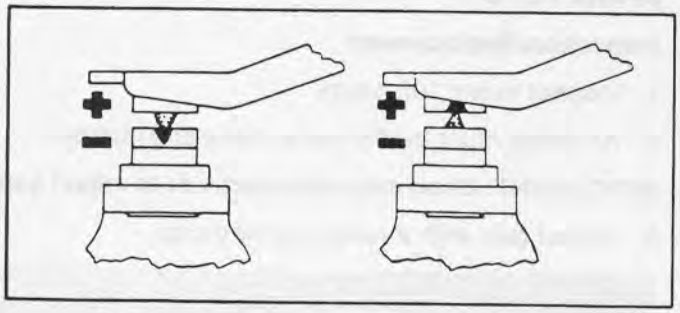
C. Badly burned or pitted contact points should be replaced and cause of trouble determined and corrected.

BURNED POINTS

1. Contact point burning results from high voltage, presence of oil or other foreign material, defective condenser, improper point adjustment, or ignition by-pass system.
2. High voltage causes excessively high current flow thru contact points which burns them rapidly. High voltage can result from improperly adjusted or inoperative voltage regulator.
3. Oil or crankcase vapors, which work up into distributor and deposit on point surfaces, cause them to burn rapidly. This is easy to detect, since oil produces a smudgy line under contact points. Clogged engine vent hoses permit crankcase pressure to force oil or vapors up into distributor. Over-oiling distributor also produces the condition.
4. If contact point opening is too small, points will be closed too much of operating time. Average current flow thru points will be too high, so points will burn rapidly and arcing will occur between points and result in low secondary voltage and engine miss.
5. High series resistance in condenser circuit will prevent normal condenser action, so contact points will burn rapidly. This resistance may be caused by a loose condenser mounting or lead connection, or by poor connections inside condenser.

PITTED POINTS

1. Contact point pitting results from an out-of-balance condition in ignition system which causes transfer of material from one point to other so that a tip builds up on one point while a pit forms in other.



Negative to Positive **Positive to Negative**

2. Direction, in which material transfers, can be used as a basis for analysis and correction of pitting. For example, if material transfers from negative to positive point one or more of these corrections may be made. Increase condenser capacity, shorten condenser lead, separate distributor-to-coil low and high-tension leads or move these leads closer to ground.
3. If material transfers from positive to negative point, reduce condenser capacity, move distributor-to-coil leads closer together, move these leads away from ground or lengthen condenser lead.

REPLACEMENT

1. Remove distributor cap.
2. Remove rotor.
3. Remove breaker plate.
4. Remove primary terminal screw.
5. Remove contact point set from breaker plate.
6. Clean breaker plate.

IMPORTANT: Wipe protective film from point set prior to installation.

7. Install new contact point assembly.
8. Connect primary and condenser lead wires to terminal on primary terminal screw.

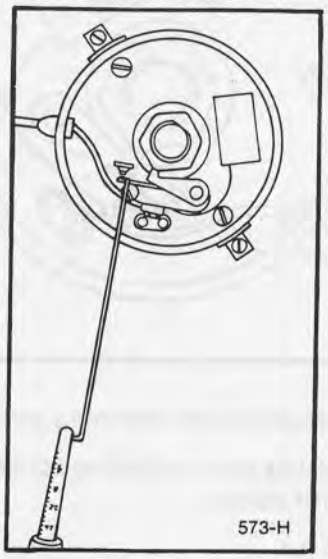
LUBRICATION

Apply a light film of suitable high melting point, non-bleeding grease on distributor cam. Repeat every 50 hours of operation or once a year.

CHECKING SPRING TENSION

Contact point pressure must fall within specified limits. Weak tension will cause chatter which results in arcing and burning of points and an ignition miss at high speed, while excessive tension will cause undue wear of contact points, cam and rubbing block.

Contact point pressure should be checked with a spring gauge. Scale should be hooked to breaker lever and pull exerted at 90° to breaker lever. Reading should be taken just as points separate. Refer to specifications for spring tension. Pressure can be adjusted by bending breaker lever spring. If pressure is excessive, it can be decreased by pinching spring carefully. To increase pressure, remove lever from distributor so that spring can be bent away from lever.

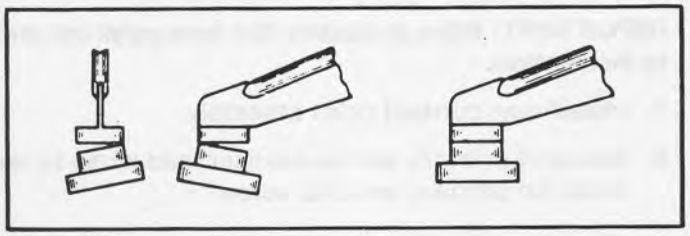


SETTING POINT ALIGNMENT and DWELL

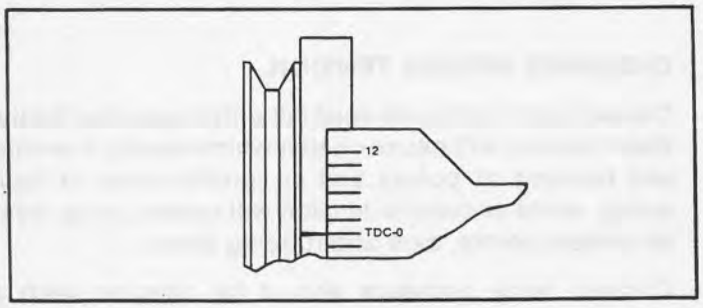
1. Set contact points with a feeler gauge to specifications.
2. New points must be set to high side of gap, as rubbing block will wear while seating to cam. Points should be cleaned before adjusting if previously in service.

Adjust point opening as follows:

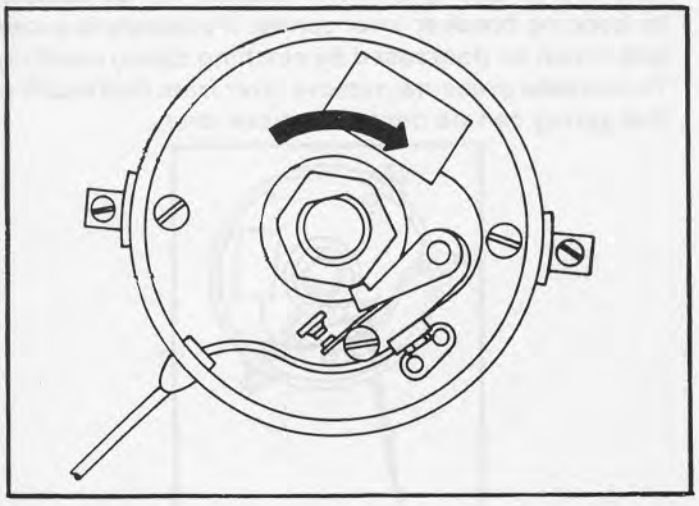
a. Align points by bending fixed contact support. Do not bend breaker lever. Align new points but replace used points if bent.



b. Rotate engine until timing mark on harmonic balancer lines up with "0" (TDC) on timing tab and engine is in #1 firing position.



c. A rounded lob must align on rubbing block of points.



d. Loosen breaker point retaining screw(s).

e. Use adjusting slots adjusting screw to obtain correct gap for points.

f. Tighten retaining screw(s) and recheck point opening.

g. After checking and adjusting contact point opening to specifications, cam angle or dwell should be checked with a dwell meter.

h. If cam angle is less than specified minimum, check for defective or misaligned contact points or worn distributor cam lobes. Variation in cam angle readings between idle speed and 1750 engine RPM should not exceed 3°. Excessive variation in this speed range indicates wear in distributor.

CONDENSER

Testing/Replacement

Use a magneto analyzer to make the following checks:

1. Condenser capacity.
2. Condenser shorts or leak.
3. Condenser series resistance.

Refer to specifications and replace condenser if not within specifications.

IGNITION COIL TESTING

Use a magneto analyzer to make the following checks:

1. Coil power.
2. Coil surface insulation.
3. Coil continuity.
4. Primary resistance.

Refer to specifications and replace condenser if not within specifications.

SPARK PLUG

Inspection/Replacement

1. Inspect every 100 hours.
2. All plugs must be the same make and number.

IMPORTANT: Bend only side electrode to adjust gap.

3. Adjust gap with a round feeler gauge.

4. Clean plug seat area. Do not use gaskets on tape seat plugs.
5. Install and torque to specifications.

SPARK PLUG WIRES

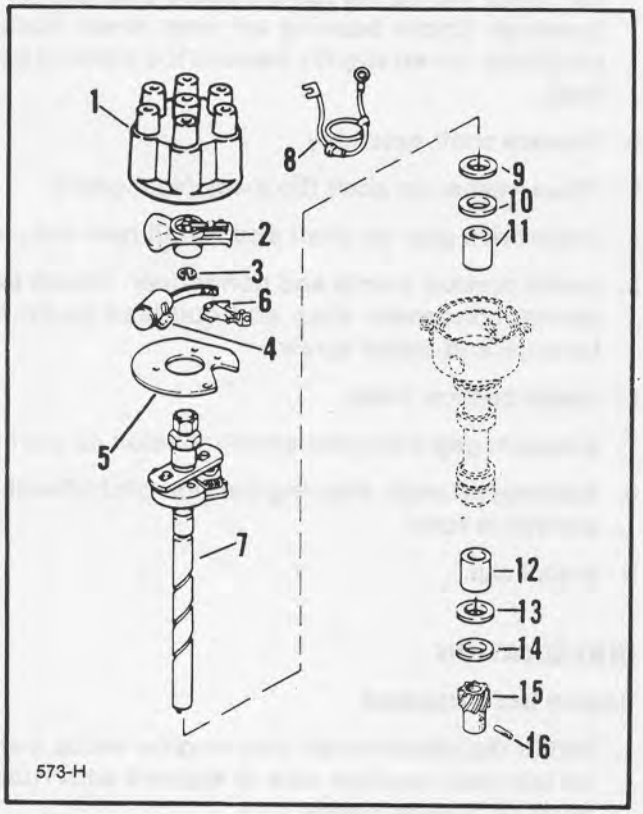
Inspection

1. Check that all wires are clean and tight.
2. Check all boots for cracks or deterioration.
3. Replace as necessary.
4. Check that all wires are at proper locations.

Prestolite Distributor

INSPECTION ON ENGINE

1. Remove distributor cap and inspect as outlined. Replace if necessary.
2. Make sure that all distributor wire terminals are clean and tight.
3. Clean and inspect rotor and breaker assembly. Replace if necessary.



1. Cap
2. Rotor
3. Lock Ring
4. Condenser
5. Breaker Plate
6. Breaker Points
7. Shaft Assembly
8. Coil Lead Wire
9. Washer
10. Washer
11. Upper Shaft Bushing
12. Lower Shaft Bushing
13. Washer
14. Washer
15. Gear
16. Drive Pin

4. Test condensor as outlined. Replace if necessary.
5. Check distributor bushings for wear. Attach dial indicator to distributor housing. Position registering point of dial indicator to rest on distributor shaft. Shaft must not have more than .002" (.05mm) side play within bushings when shaft is pushed back-and-forth by hand.
6. Check for sticking centrifugal weights. Grip distributor shaft (or rotor) and twist in direction of rotation, then release. Shaft should snap back to its original position. If it hangs up, returns sluggishly or slowly, shaft assembly must be replaced, or rebuilt.

REMOVAL

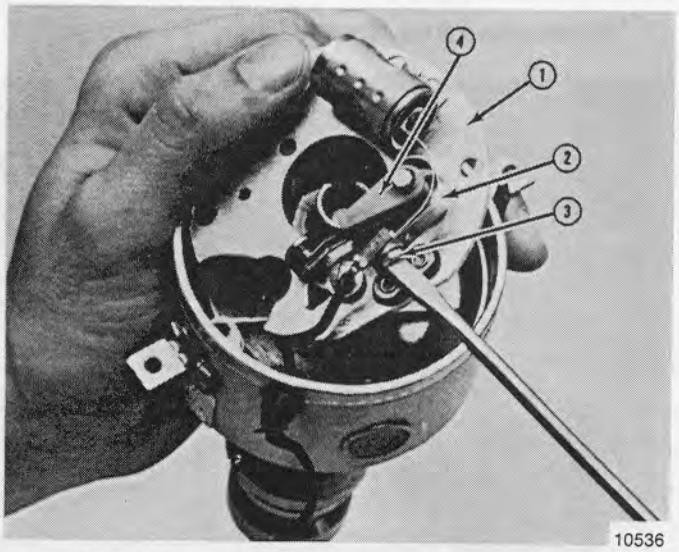
1. Disconnect coil primary lead from coil.
2. Remove distributor cap, leaving all wires in place.
3. Crank engine slowly to align timing marks when rotor is pointing to the number 1 terminal of distributor cap. If same distributor is to be reinstalled in engine, mark position of distributor housing in relation to engine so that distributor may be installed in same position.
4. Remove distributor retaining clamp and distributor.

IMPORTANT: To simplify reinstallation, DO NOT turn crankshaft with distributor removed.

DISASSEMBLY

IMPORTANT: DO NOT disassemble distributor if not necessary. When checking for worn parts, refer to ("Inspection on Engine"), preceding. When disassembling distributor, use soft wood blocks to hold it in a vise.

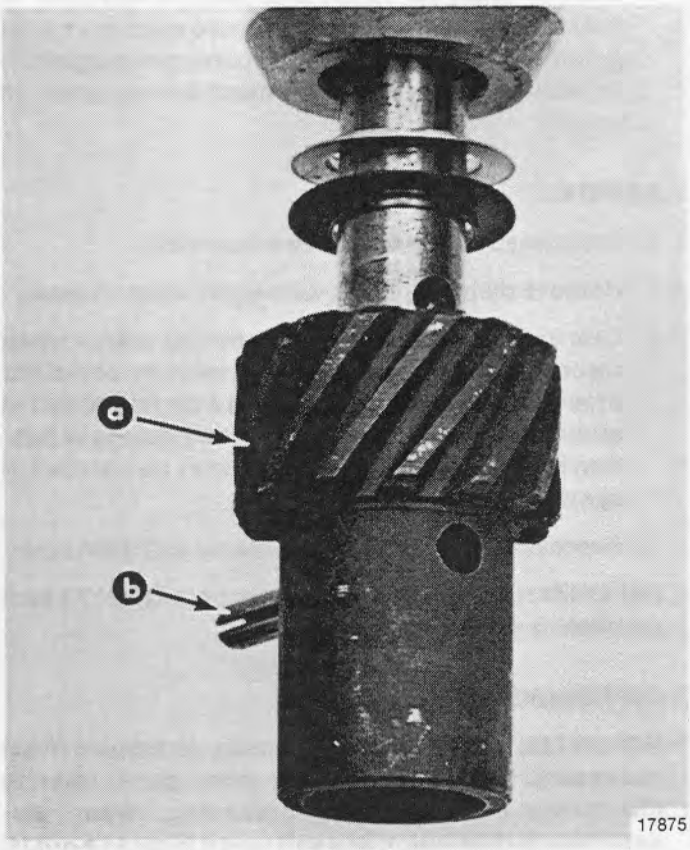
1. Lift rotor off.
2. Remove breaker plate and lift from housing.
3. Remove primary terminal screw and washer. Remove condenser and contact points from plate.



1 - Breaker Plate
2 - Condenser Lead Strap
3 - Primary Terminal Screw
4 - Breaker Points

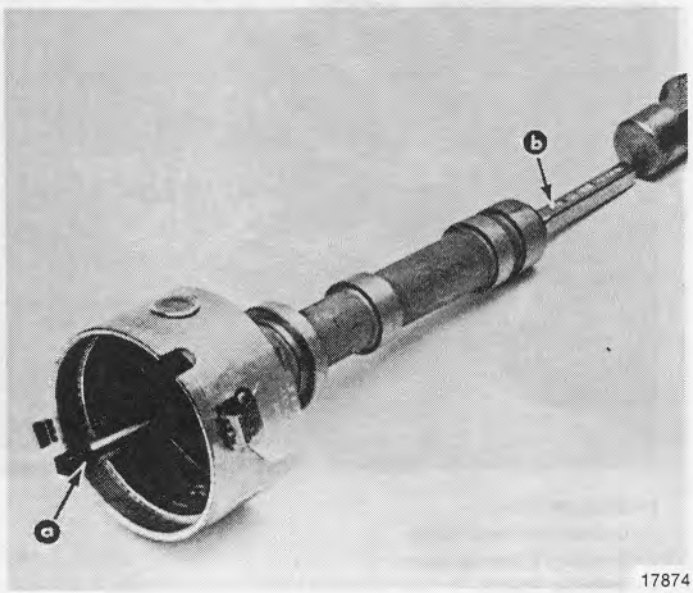
NOTE: Proceed with Steps 4, 5, 6, 7, ONLY if shaft assembly or shaft bushings in housing are to be replaced.

4. Drive pin from gear and remove gear.



a - Gear
b - Pin

5. Remove shaft assembly.
6. Thread a 1/2x13 or 1/2x20 tap into the upper shaft bushing. Using a punch drive tap and bushing out of housing.
7. Repeat Step 6 for lower bushing.



a - Tap
b - Punch

INSPECTION/CLEANING

1. Wash breaker plate, gear, collar and all washers and fasteners in cleaning solvent. If bushings are removed wash housing in solvent after removing coil lead wire. DO NOT wash points, condenser or any non-metal parts in solvent.
2. Inspect contact points as outlined. Replace if necessary.
3. Inspect advance weights for wear or burrs and free fit on their pins. If worn, replace distributor shaft assembly.
4. Inspect cam for wear or roughness. Check cam fit on end of shaft. It should be free, but not loose. If worn, replace distributor.

REASSEMBLY

1. If bushing were removed from housing, drive in NEW bushings, using 1/2" socket or other cylindrical object having the same outside diameter as the bushings. Upper bushing will seat, lower bushing should be driven slightly beyond the point of being flush.
2. Replace shaft assembly.
3. Place washer on shaft (lip away from gear).
4. Place drive gear on shaft and install new roll pin.
5. Install breaker points and condenser. Attach point spring, condenser strap and coil lead to primary terminal and install screw.
6. Install breaker plate.
7. Set point gap and point spring tension as outlined.
8. Set rotor on shaft, aligning flat side of shaft with flat surface in rotor.
9. Install cap.

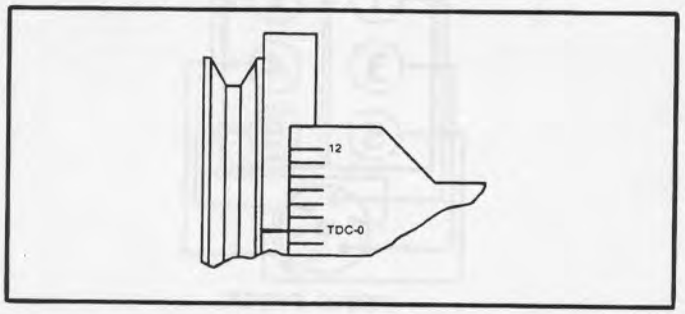
INSTALLATION

Engine Not Disturbed

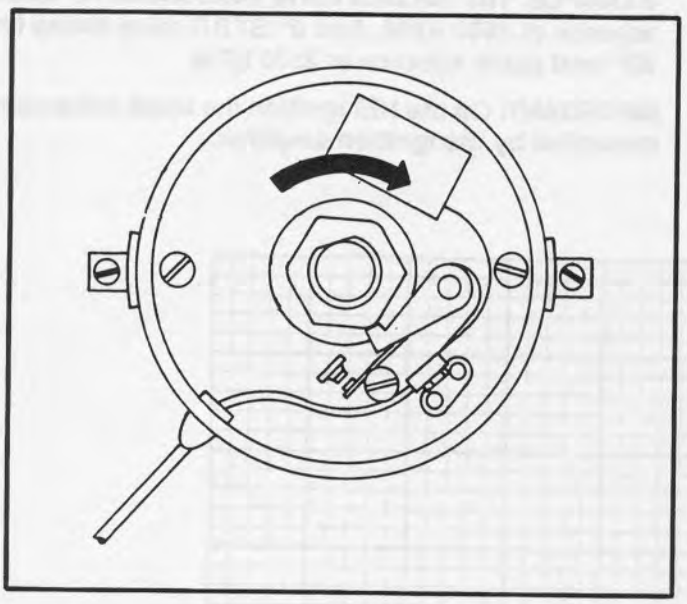
1. Install distributor shaft into engine while making certain that rounded lobe is aligned with rubbing block of breaker points.
2. Align marks made at time of removal and tighten clamp to specifications.
3. Set engine timing with timing light.

Engine Disturbed

1. Rotate engine (in normal direction of rotation) until timing mark on crankshaft balancer lines up with "0" (TDC) on timing tab and engine is in number 1 firing position.



2. Look closely at the cam in the distributor. You will notice that three of the lobes have a sharper profile than the other three. They are situated sharp-round-sharp-round, etc.



3. Install distributor into engine so that when the rotor is aligned with the number 1 spark plug tower, a rounded lobe is aligned with the rubbing block of the breaker points.
4. Secure distributor with clamp and check engine timing with timing light.

Ignition Timing

1. Connect timing light to number 1 spark plug lead, at or near spark plug. Connect power supply leads on light to battery (12 volts).
2. Connect tachometer to engine.
3. Start engine and run at normal idle speed.
4. Aim timing light at timing tab, located on timing gear cover and crankshaft harmonic balancer.
5. Adjust timing by loosening distributor clamp and rotating distributor body until timing mark on balancer lines up with mark on tab specified in "Specifications". Tighten clamp and recheck location of timing mark.
6. Stop engine and remove timing light.

Thunderbolt IV (HEI) System

Torque Specifications

Fastener Location	Lbs. Ft. (N.m)
Distributor Clamp 3/8-16	20 (27)
Spark Plugs (14mm)	15 (20)

Tools/Lubricants/Sealants

TOOLS	
91-52024A1	Remote Starter Switch
91-63998	Spark Gap Tester
91-99379	Timing Light
91-63209	Torch Lamp
91-99750	Volt/Ohmmeter

LUBRICANTS/SEALANTS	
92-90018	2-4-C Lubricant
92-41669	Insulating Compound
92-25711	Liquid Neoprene
92-32609	Quicksilver Loctite "A"

Specifications

UNIT OF MEASUREMENT in. (mm)

COIL

Coil Part Number	392-7803
Primary Resistance*	.60 - .80 Ohms
Secondary Resistance*	9,400 - 11,700 Ohms

NOTE: *Use magneto analyzer

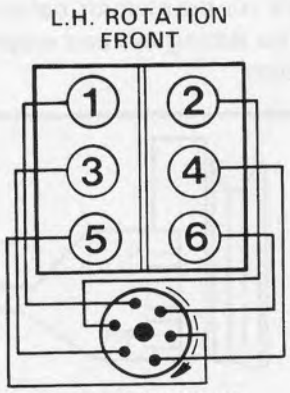
TIMING

Model	175/185/4.3L/ 205/4.3LX
Timing	8° BTDC

SPARK PLUGS

Model	MCM 185, 175, 4.3 Litre, 205, 4.3 Litre LX
Spark Plug Gap	.035 (.9)
Spark Plug Type	AC-MR43T/Champion-RV15YC4

FIRING ORDER



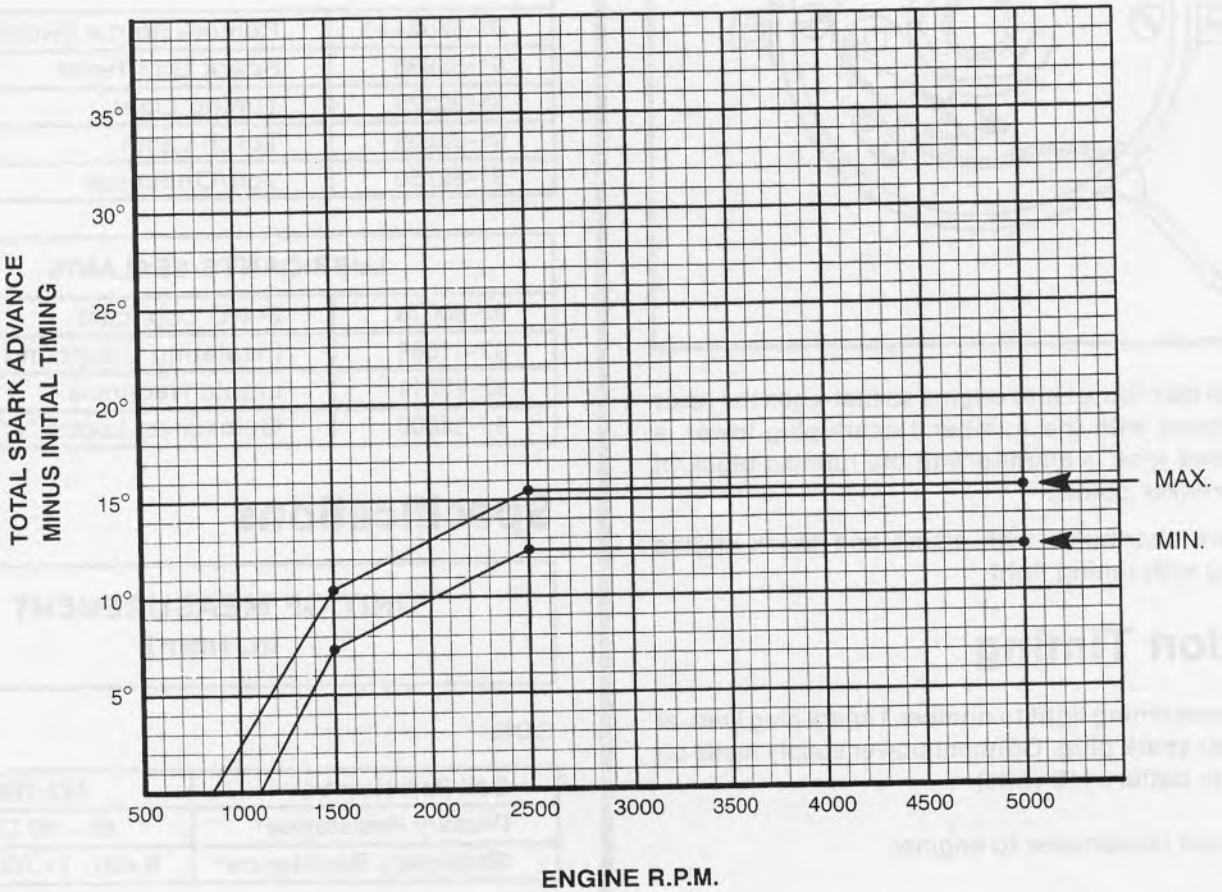
1443-H

Distributor Advance Curve

IMPORTANT: Distributor advance curve charts do not include the initial engine timing. Basic initial timing must be added to chart for total advance curve.

EXAMPLE: The advance curve chart shows 14° spark advance at 2500 RPM. Add 8° BTDC initial timing for 22° total spark advance at 2500 RPM.

IMPORTANT: On the HEI ignition the spark advance is controlled by the ignition amplifier.



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Repair

Precautions

⚠WARNING

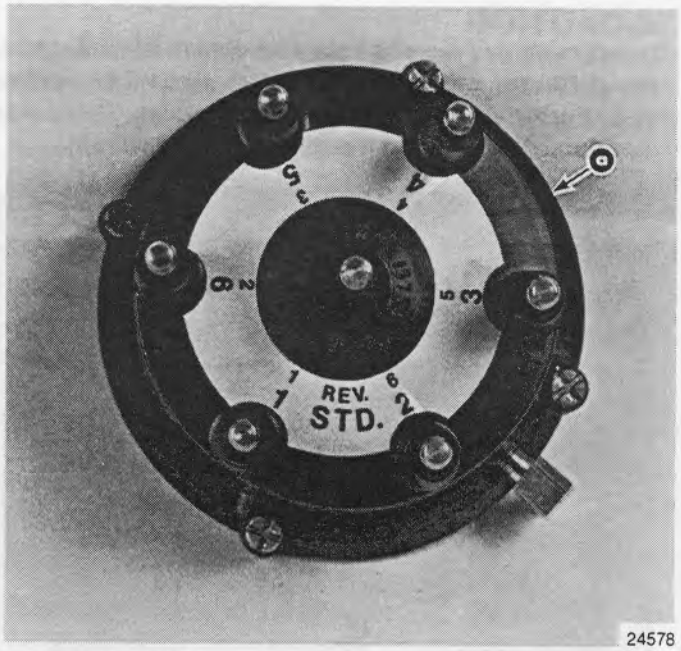
When performing the following procedure, be sure to observe the following:

- **Be sure that engine compartment is well ventilated and that no gasoline vapors are present, to avoid the possibility of fire.**
- **Be sure to keep hands, feet, and clothing clear of engine moving parts.**
- **Do not touch or disconnect any ignition system parts while engine is running.**
- **Do not reverse battery cable connections. System is negative (-) ground.**
- **Do not disconnect battery cables while engine is running.**

Distributor Cap

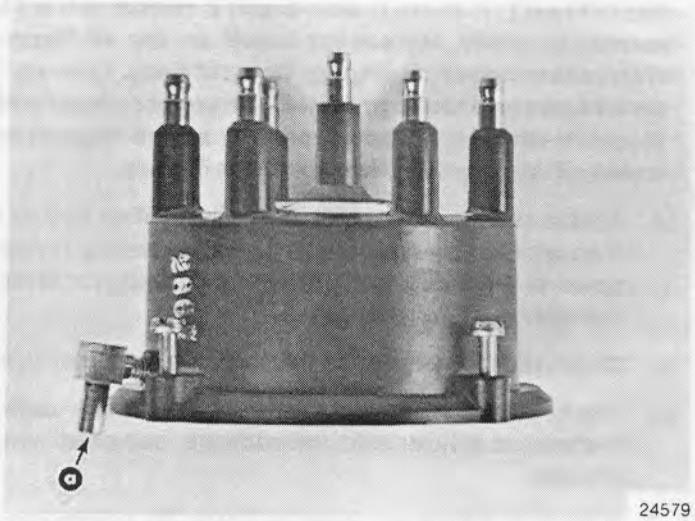
1. Loosen four distributor cap retaining screws.
2. Remove distributor cap.
3. Clean cap with warm soap and water and blow off with compressed air.
4. Check cap contact for excessive burning or corrosion. Check center contact for deterioration.
5. Check cap for cracks or carbon tracks using Magneto Analyzer.

IMPORTANT: If high tension leads are removed from cap refer to Figures following for installation.



24578

a - Alignment Notch

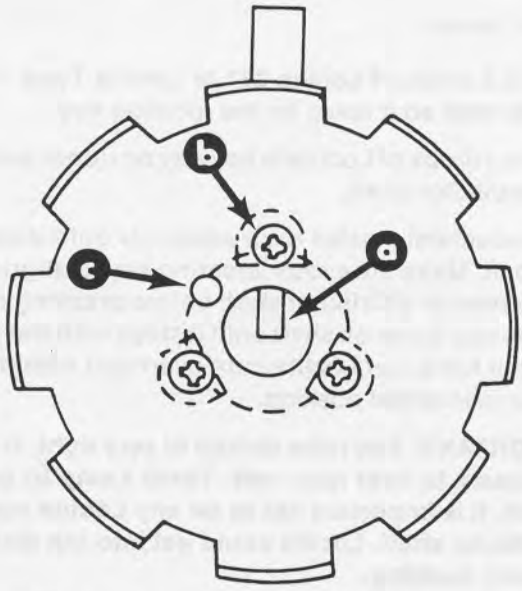


24579

a - Vent

Rotor and Sensor Wheel

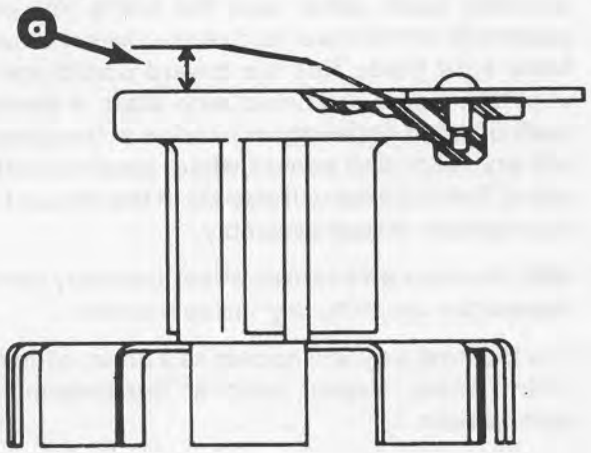
1. Remove distributor rotor/sensor wheel assembly from distributor shaft. Rotor and sensor wheel are Loctited onto shaft. Use two 3/8" (10mm) wide flat blade screwdrivers approximately 8" (203mm) to 10" (254mm) long. The screwdrivers are positioned opposite each other with the blade tips on the underside of the rotor and sensor wheel assembly. Make sure blade tips are toward distributor shaft until they come in contact with shaft. A downward push on both screwdriver handles at the same time will pry rotor and sensor wheel assembly off. The use of Torch Lamp will also aid in the removal of the rotor/sensor wheel assembly.
2. With the rotor and sensor wheel assembly removed, inspect the locating key inside the rotor.
3. The locating key will appear as a clean edged, 1/8" (3mm) wide, sloped ramp at the bottom of the splined hole.



a - Locating Key
b - Phillips Screws
c - Sensor Wheel
d - Locating Pin

IMPORTANT: If there is any doubt if sensor wheel is located properly, lay sensor wheel on top of Figure with sensor fingers facing up (toward you). Line up 3 screw holes and locating pin hole on sensor wheel with Figure. If wheel is indexed properly all the fingers on wheel will line up with the one in the Figure.

4. If there are pieces of material shaved off of key or if it appears to have been damaged by being forced down while misaligned with slot in distributor shaft, the rotor must be replaced.
5. Check rotor for burned or corroded center contact.
6. Check rotor for cracks and carbon tracks using magneto analyzer and instructions supplied with analyzer.
7. If rotor is damaged, replace rotor by removing 3 phillips screws and separating sensor wheel from rotor. Reinstall sensor wheel to new rotor making sure locating pin on rotor is installed in locating hole in sensor wheel. Tighten 3 phillips screws securely.
8. Bend carbon brush tang upward slightly until a distance of 1/4" (6.5mm) is obtained between rotor and tang.



a - 1/4" (6.5mm)

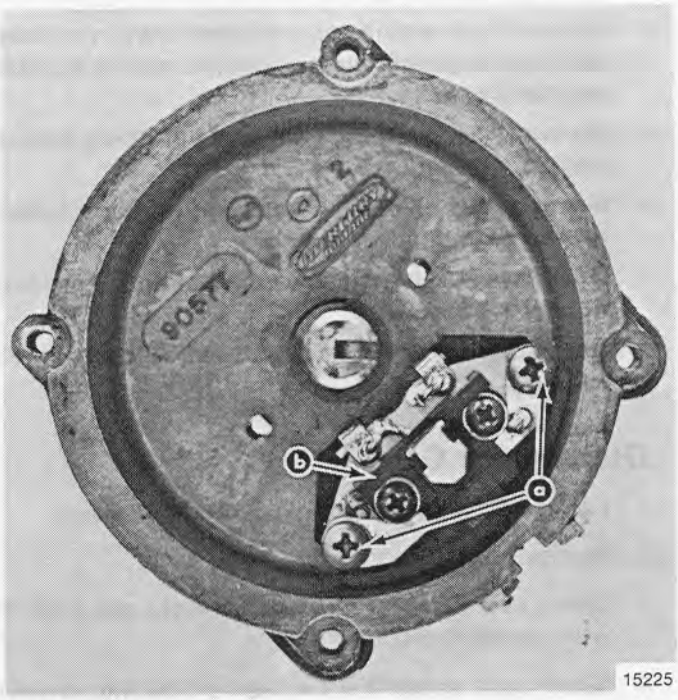
9. Put 2 drops of Loctite 271 or Loctite Type "A" into the rotor so it lands on the locating key.
10. Put 2 drops of Loctite in keyway on upper portion of distributor shaft.
11. Immediately install rotor assembly onto distributor shaft. Make sure rotor locating key is aligned with keyway in distributor shaft before pressing rotor all the way down on shaft until it stops with the palm of your hand. Let Loctite cure overnight with distributor in inverted position.

IMPORTANT: The rotor should fit very tight. It may be necessary to heat rotor with Torch Lamp to properly install. It is important not to let any Loctite run down distributor shaft. Loctite could get into top distributor housing bushing.

12. Reinstall distributor cap on distributor.

Sensor

1. Remove rotor and sensor wheel.
2. Remove 2 screws that hold sensor into distributor housing.
3. Remove sensor from housing.

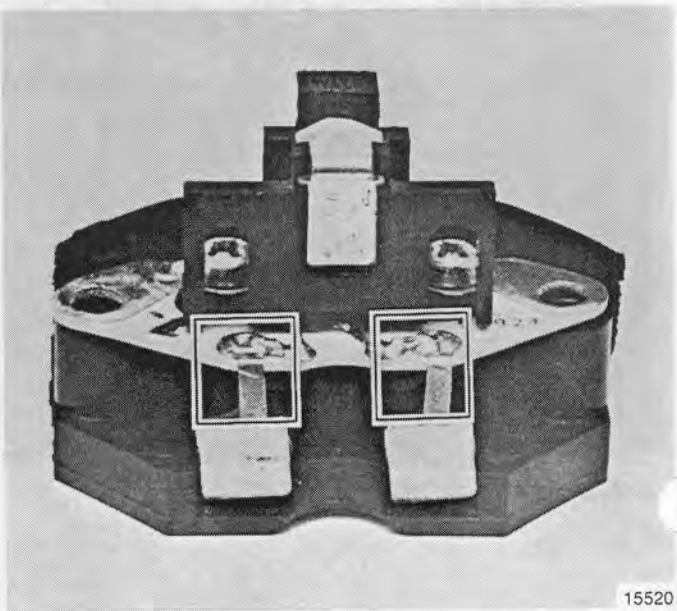


a - Mounting Screws
b - Sensor Assembly

4. Use a magnifying glass and light to inspect the two metal "jumper leads" for cracks. If a crack is found in either metal "jumper lead", install a new sensor.

⚠CAUTION

Do not use any type of silicone sealer on the inside of the distributor. Most silicone sealers give off an acidic vapor during the curing stage of the sealer. This acid can cause corrosion on the ignition components.



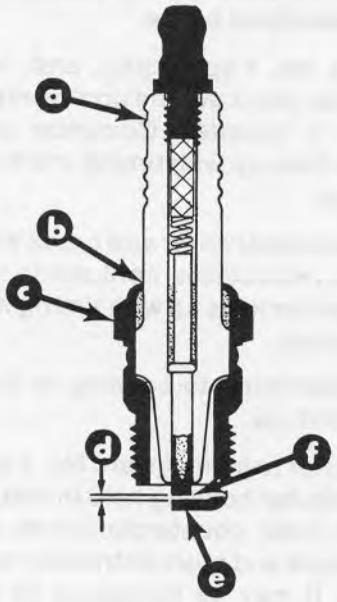
5. Install sensor into housing and install 2 retaining screws.
6. Install sensor wheel, rotor, and distributor cap.

Spark Plugs

1. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered porcelain and replace where necessary.
2. Inspect each spark plug for make and heat range. All plugs must be the same make and number or heat range. Refer to "Specifications" for spark plug numbers.

IMPORTANT: Never bend the center electrode to adjust gap. Always adjust by bending ground or side electrode.

3. Adjust spark plug gaps with a round feeler gauge. Refer to "Specification" for proper spark plug gap.



50674

a - Porcelain Insulator
b - Insulator Cracks Often Occur at this Point
c - Shell
d - Proper Gap
e - Side Electrode (Bend to Adjust Gap)
f - Center Electrode (File Flat When Adjusting Gap - Do Not Bend)

4. Clean spark plug seating area. Do not use gaskets on taper seat plugs. Install spark plugs and torque to specifications. Where used, gasket must be fully compressed to complete heat transfer and provide a gas-tight seal in cylinder. For this reason, as well as necessity of maintaining correct plug gap, correct torque is very important during installation.

IMPORTANT: Tapered seat spark plugs are not interchangeable with nontapered (with gasket) spark plugs.

High Tension Leads

1. Inspect high tension leads for damage.
2. Check high tension leads for continuity.
3. Replace any leads that are cracked, cut, or have damaged spark plug boots.
4. Replace any leads that do not show continuity from end to end.
5. Reinstall high tension leads in proper order.

IMPORTANT: Before installing high tension lead to coil, apply approximately 1/2 oz. of insulating compound (P/N 92-41669) inside nipple of high tension lead. Force nipple into coil and wipe off excess.

IMPORTANT: Proper positioning in high tension lead supports is important to prevent cross firing.

IMPORTANT: Black boot is distributor end of spark plug wire. Gray (or Red) boot is spark plug end of wire.

Distributor Repair

Removal

1. Remove distributor cap. Do not remove high tension leads unless necessary.
2. Crank engine over until timing marks line up and rotor is pointing towards No. 1 cylinder on distributor cap.
3. Mark distributor housing in reference to engine block.
4. Remove bolt and hold down clamp and remove distributor.

IMPORTANT: To simplify distributor installation, do not turn crankshaft with distributor removed from engine.

Disassembly

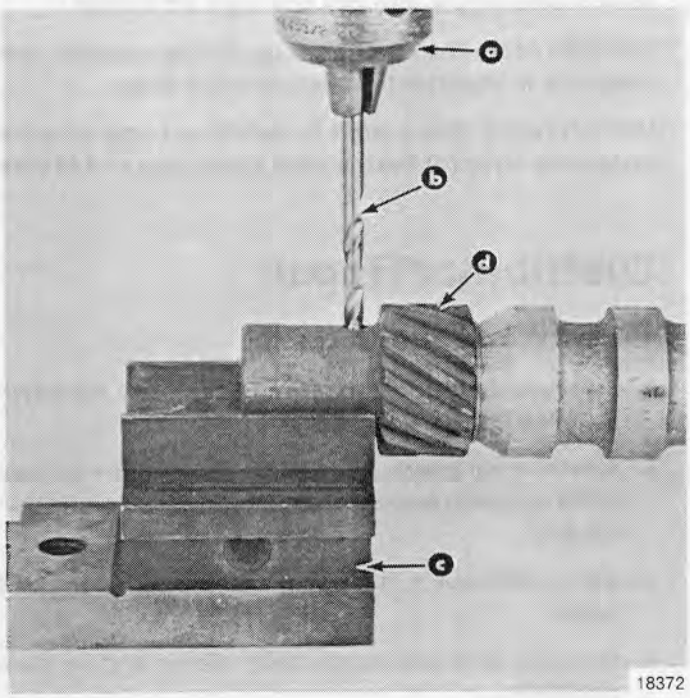
1. Remove rotor, sensor wheel, and sensor as previously outlined.
2. Remove roll pin, washer and driven gear from distributor shaft.
3. Check for side play between shaft and distributor housing bushings. Maximum side play is .002 in. (.05mm).
4. Remove shaft from housing and check shaft for being bent with a dial indicator and V-blocks. Maximum runout is .002 in. (.05mm).

Reassembly

1. Lubricate shaft with engine oil. Install "E" clip (if removed) on shaft. Install shaft in housing.
2. Install washer on shaft. Install original gear slide onto shaft and install roll pin.

IMPORTANT: Hole may be offset and gear will only fit in one direction.

3. If installing a new gear, the gear will come drilled on one side. Slide gear onto shaft, line hole in gear with hole in shaft. Using these holes as guides, drill through other side of gear with a 3/16" carbide tipped drill.



a - Drill Press
b - 3/16" Carbide Tip Drill
c - V-Block
d - New Gear

4. Install sensor, sensor wheel, and rotor as previously outlined.
5. Install distributor as outlined in "Distributor Installation".

Distributor Installation

Engine Not Disturbed

1. Install new gasket on distributor housing.
2. Turn rotor approximately 1/8-turn in a counterclockwise direction past mark previously scratched on distributor housing.
3. Work distributor down into position in engine block with distributor positioned as noted during removal.

IMPORTANT: It may be necessary to move rotor slightly to start gear into mesh with camshaft gear, but rotor should line up with the mark when distributor is down in place. Distributor shaft must enter oil pump shaft for complete installation.

4. Replace and tighten distributor hold-down bolt and clamp. Connect leads. Also install spark plug and coil secondary wires, if removed.

IMPORTANT: Wires must be installed in supports, to prevent cross-firing. Refer to "Specifications", for firing order.

5. Install cap.
6. Time ignition as outlined under "Ignition Timing".

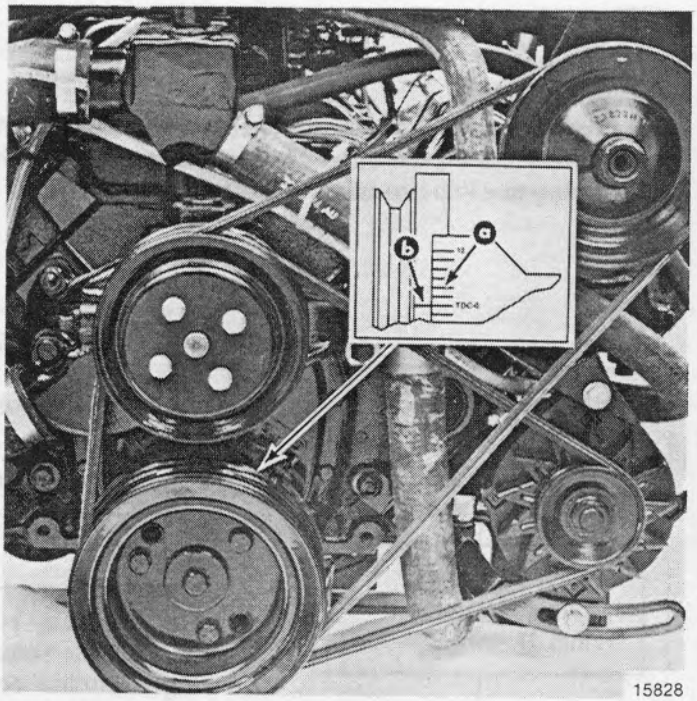
Engine Disturbed

1. Locate No. 1 piston in firing position by either of 2 methods described below.
   a. Remove No. 1 spark plug and, with finger on plug hole, crank engine until compression is felt in No. 1 cylinder. Continue cranking until pointer lines up with timing mark on crankshaft pulley or. . .
   b. Remove rocker cover and crank engine until No. 1 intake valve closes, continuing to crank slowly until pointer lines up with timing mark on crankshaft pulley.
2. Position distributor to opening in block in normal installed attitude.
3. Position rotor to point toward No. 1 cylinder on cap (with distributor housing held in installed attitude), then turn rotor counterclockwise approximately 1/8-turn more and push distributor down to engage camshaft. It may be necessary to rotate slightly until camshaft engagement is felt.
4. While pressing down firmly on distributor housing, engage starter a few times to make sure oil pump shaft is engaged. Install hold-down clamp and bolt and snug up bolt.
5. Place distributor cap in position and check that rotor lines up with terminal for No. 1 spark plug.
6. Install cap and distributor leads. Check all high tension wire connections and connect spark plug wires, if they have been removed. Wires must be installed in their proper location in supports to prevent cross-firing. Refer to "Specifications" for firing order.
7. Time ignition as outlined under "Ignition Timing".

Ignition Timing

1. Connect timing light to No. 1 spark plug. Connect power supply leads on light to battery (12 volts). Refer to "Specifications" for cylinder numbering and location.
2. Connect tachometer to engine.
3. Start engine and run at normal idle speed.
4. Aim timing light at timing tab, located on timing gear cover and crankshaft harmonic balancer.
5. Adjust timing by loosening distributor clamp and rotating distributor body as required until timing mark on balancer or pulley lines up with mark on tab specified in "Specifications". Tighten clamp and recheck location of timing mark.
6. Stop engine and remove timing light.

IMPORTANT: GM engine timing marks (on tab) are in 2° increments. MCM engines will have "A" (Advance) mark to left of "O". Timing must be set on the "A" side of "O" (Top Dead Center).

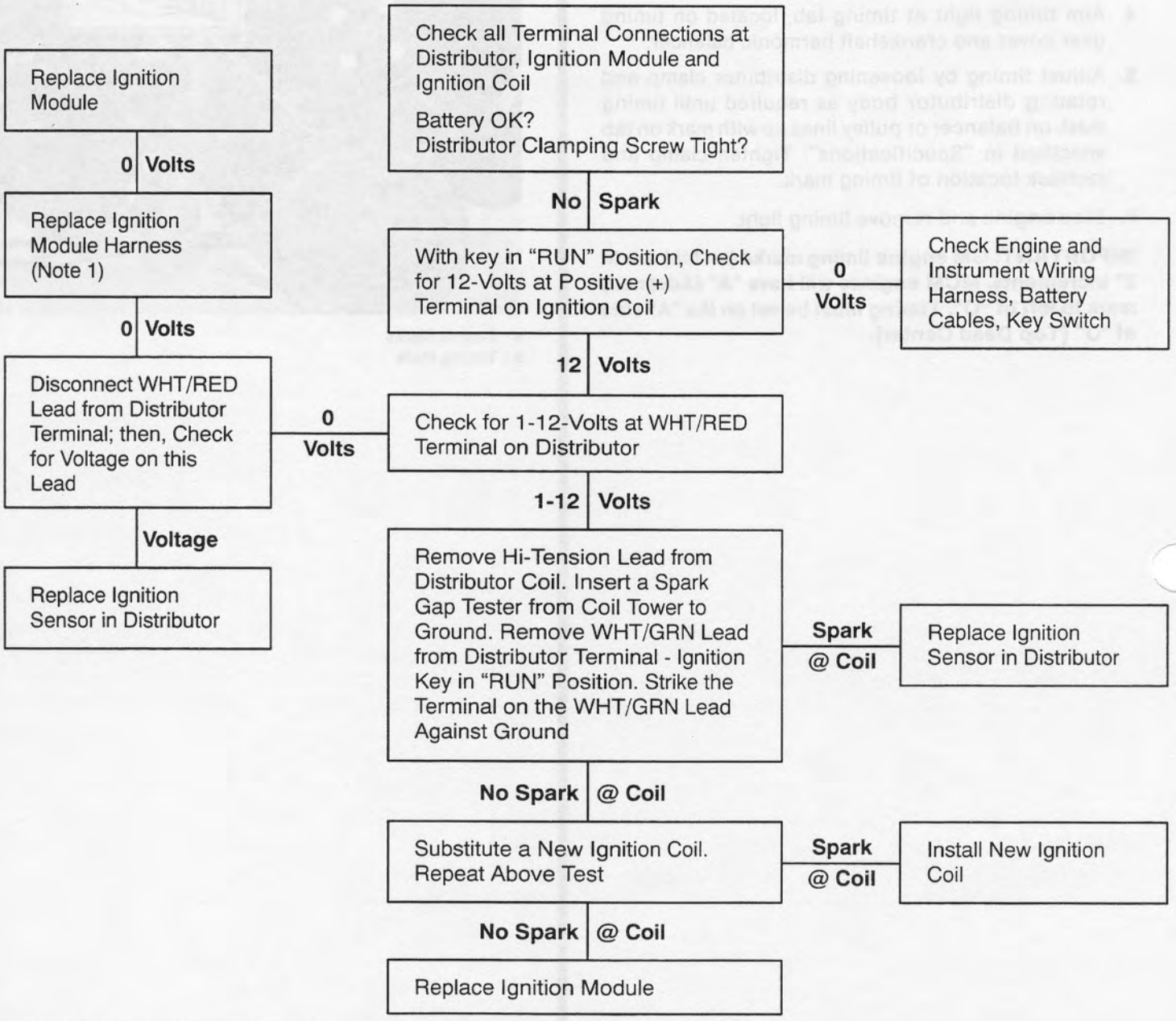


15828

a - Degree Marks
b - Timing Mark

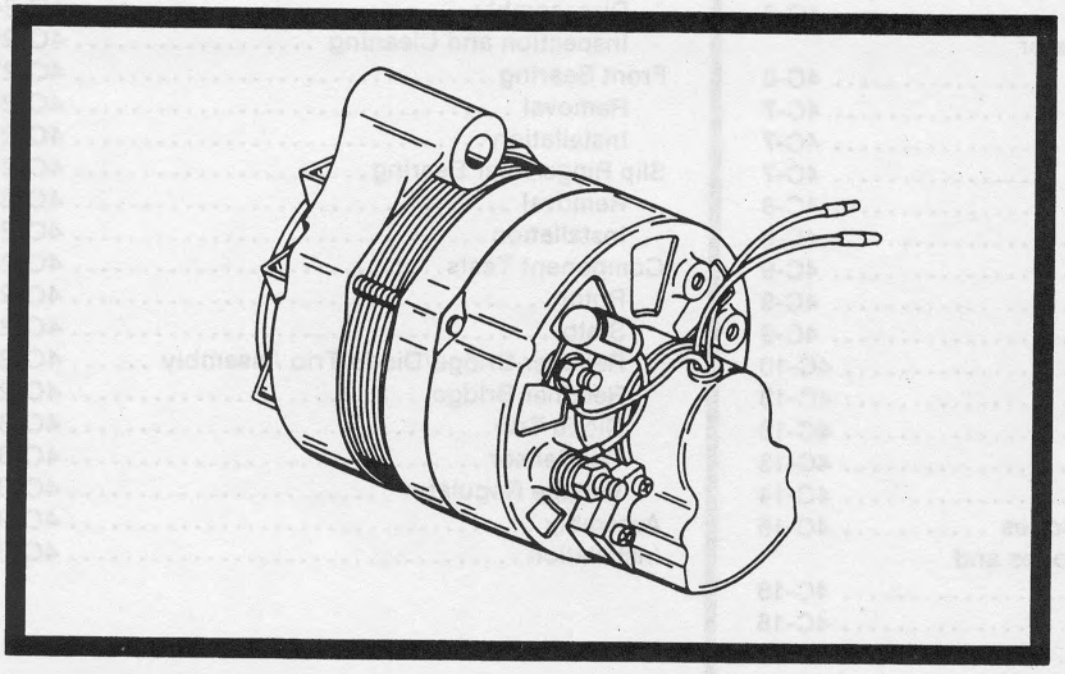
Testing HEI System

⚠WARNING
Be sure that engine compartment is well ventilated and that there are no gasoline vapors present during the following test - to prevent a potential fire hazard.



NOTE 1: Early, large ignition modules did not have a replaceable wiring harness.

ELECTRICAL SYSTEMS



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C

CHARGING SYSTEMS

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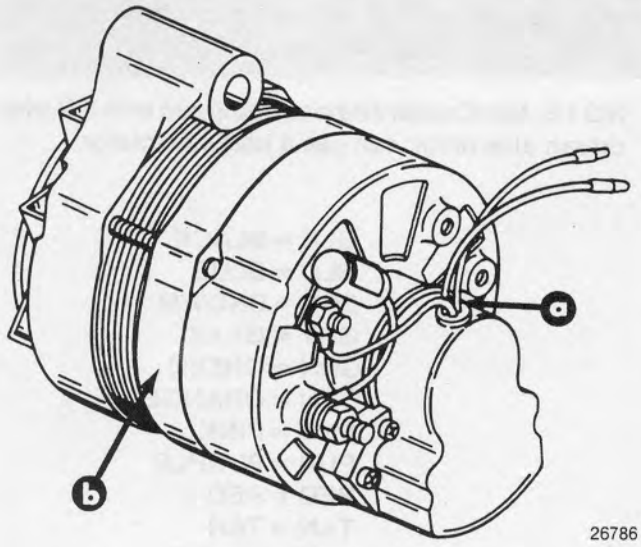
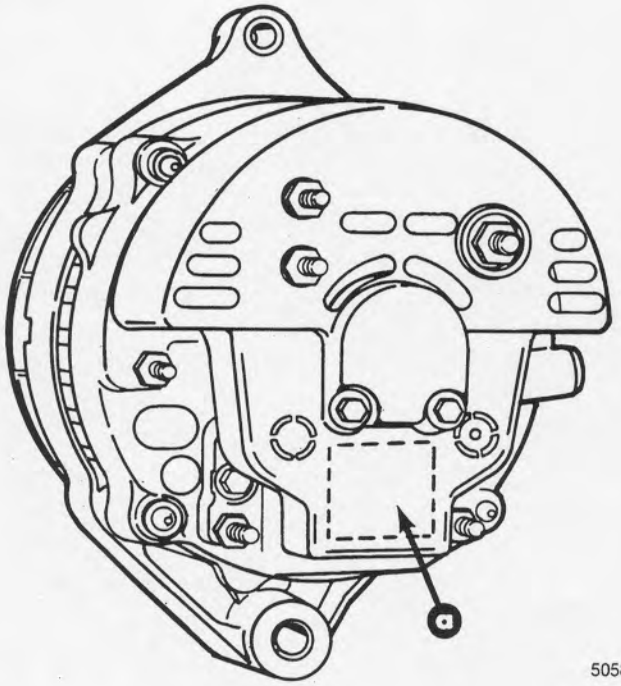
Identification



26786

a - 2 Wires Going to Engine Harness Coming Out the Top of Regulator
b - Mando Number

Mando



50580

a - Prestolite Number

Prestolite

Replacement Parts Warning

⚠WARNING

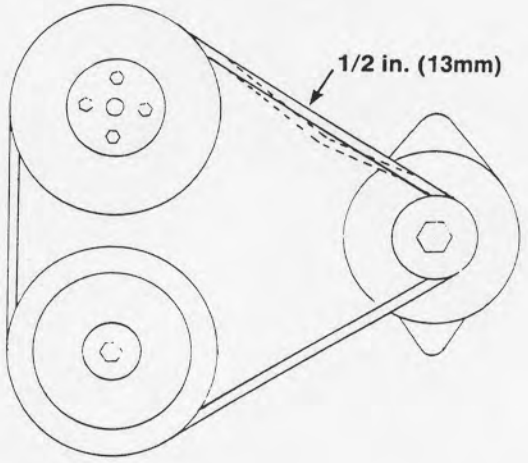
Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Drive Belt Tension Adjustment

Alternator

1. Install drive belt on pulleys and adjust tension as follows:
   a. Pivot alternator away from engine, as required, until correct tension is obtained as shown.
   b. After obtaining correct tension, securely retighten alternator brace attaching bolts and alternator mounting bolts.



Alternator Drive Belt Tension

2. If a new drive belt has been installed, recheck belt tension after running for 5 minutes.

Battery Isolators

Dual Battery Charging Systems Using A Battery Isolator

Battery isolators allow the addition of an auxiliary (second) battery to the MerCruiser electrical system. The auxiliary battery is primarily used as a power source for various accessories installed on the boat. The battery isolator will allow the alternator to charge both the cranking and auxiliary batteries at the same time while preventing accessories, connected to the auxiliary battery, from drawing power from the cranking battery.

Mercury Marine does not manufacture any battery isolator systems. Battery isolators must be bought from an outside manufacturer. Mercury Marine suggests following the manufacturer's instruction carefully.

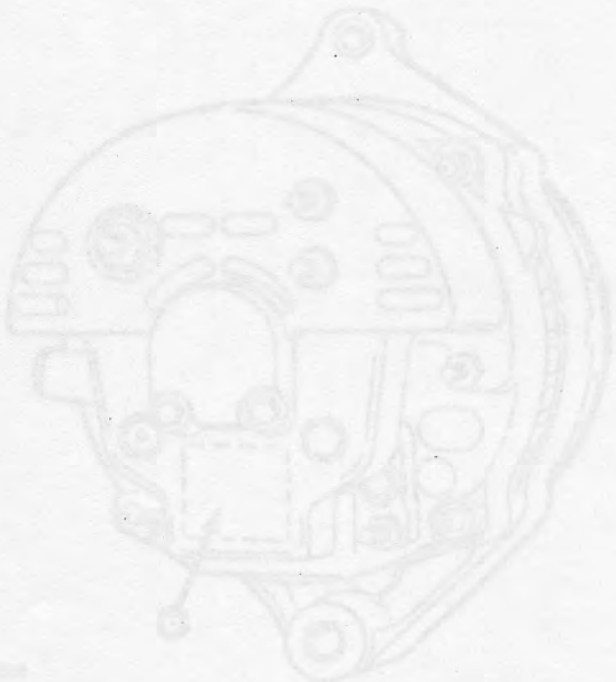
IMPORTANT: Alternators used on MerCruiser engines ARE NOT equipped with an isolation diode.

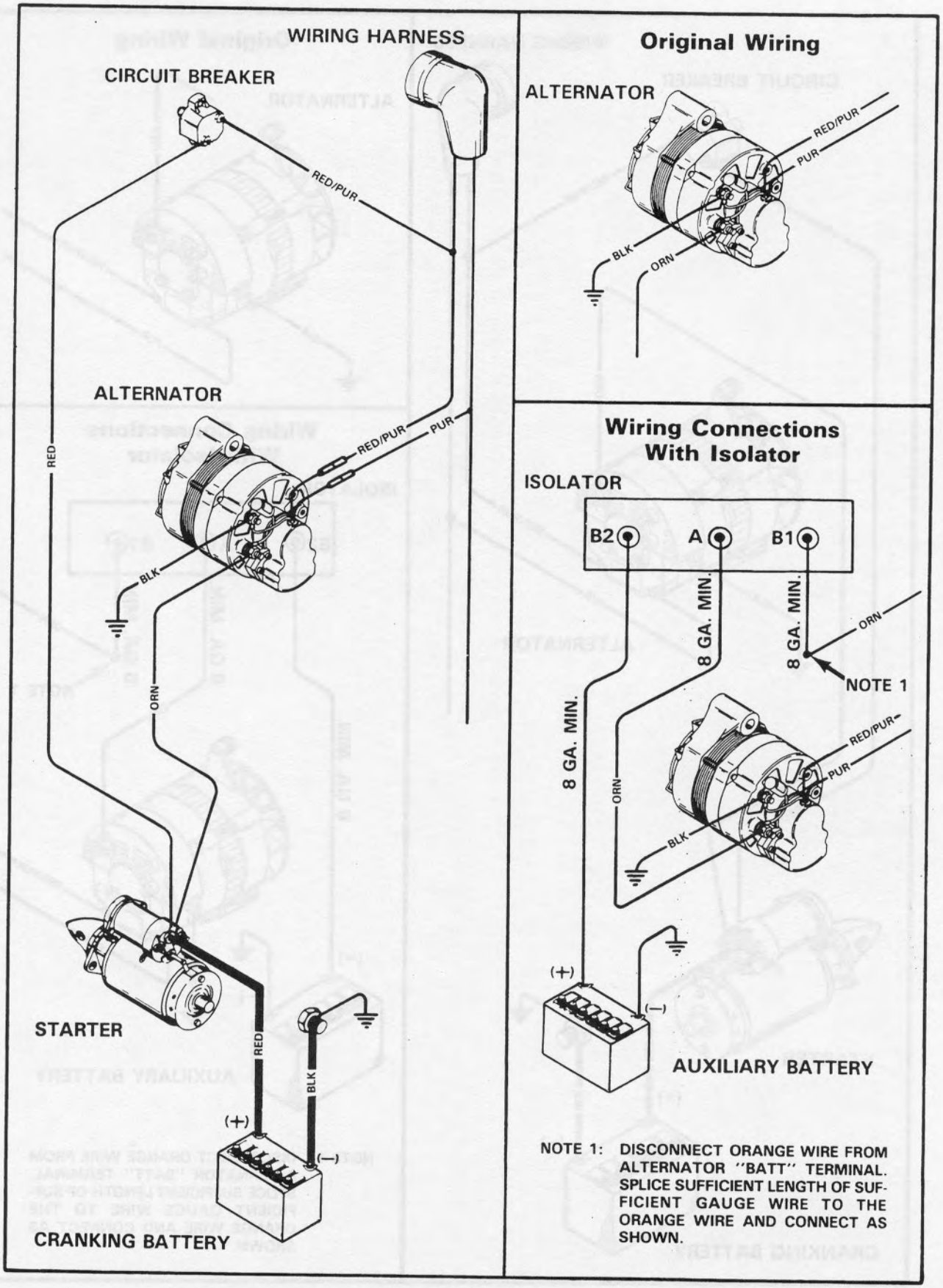
⚠CAUTION

Follow battery isolator manufacturer's instructions for wire gauge. Battery isolator installation must conform to BIA Low Voltage Wiring Standard No. 125-79.

NOTE: MerCruiser engines equipped with a 3-wire, belt driven alternator, can use a battery isolator.

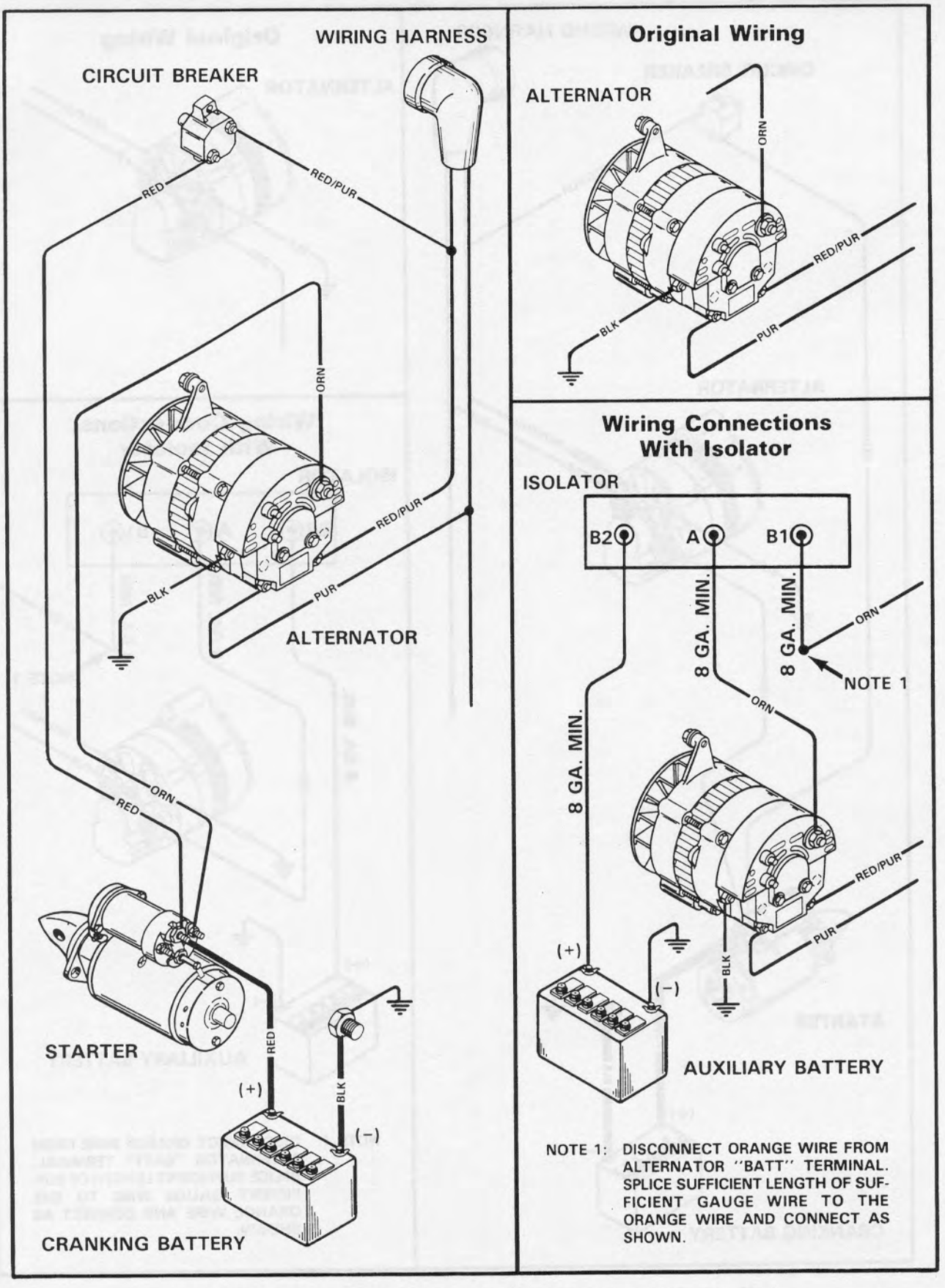
BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
ORN = ORANGE
PNK = PINK
PUR = PURPLE
RED = RED
TAN = TAN
WHT = WHITE
YEL = YELLOW
LIT = LIGHT
DRK = DARK





50700

Mando Alternator with Voltmeter Circuit (Typical Wiring Shown)



Prestolite Alternator with Voltmeter Circuit (Typical Wiring Shown)

Mando Alternator

Torque Specifications

Fastener Location	Lb. Ft. (N·m)	Lb. In. (N·m)
Alternator Brace To Alternator		192 (28)
Alternator Brace To Block	30 (41)	
Alternator To Mounting Bracket	35 (48)	
Alternator Mounting Bracket	30 (41)	
Brush Retaining Screws	Securely	
Pulley Nut	50 (68)	
Rectifier Heat Sinks	Securely	
Regulator Retaining Screws	Securely	
Thru Bolts	Securely	

Tools/Sealants

MERCURY MARINE SPECIAL TOOLS	
91-31229A5	Bearing Removal and Installation Kit
91-76032	Magneto Analyzer
91-37241	Universal Puller Plate
91-99750	Multi-Meter/DVA Tester

TOOLS PURCHASED LOCALLY
Ammeter (0-50 Amps)

SEALANTS	
92-25711	Quicksilver Liquid Neoprene

Specifications

Mercury Number (Mando Number)	Amp Output (Max.)	Rotation
98555 (AR150AA)	55	Uni-Directional

Description

The alternator system, used on engines with Mando Alternators, consists of the alternator, battery, the ignition switch and the wiring which connects these components. Refer to "Section 4, Part F" for wiring diagrams.

The alternator employs a rotor, which is supported in 2 end frames by ball bearings, and is driven (via a pulley) at approximately twice engine speed. The rotor contains a field winding that is enclosed between 2 multiple-finger pole pieces. The ends of the field winding are connected to 2 brushes (mounted in the rear end frame) which make continuous sliding (or slipping) contact with the slip rings. The current (flowing through the field winding) creates a magnetic field that causes the adjacent fingers of the pole pieces to become alternate north and south magnetic poles.

A 3-phase stator is mounted directly over the rotor pole pieces and between the 2 end frames. It consists of 3 windings wound 120° electrically out-of-phase on the inside of a laminated core. The windings are all connected together on one end, while the other ends are connected to a full-wave rectifier bridge.

The rectifier bridge contains 6 diodes which are arranged so that current flows from ground, thru the stator and to the output terminal, but not in the opposite direction.

When current is supplied to the rotor field winding, and the rotor is turned, the movement of the magnetic fields created induces an alternating current into the stator windings. The rectifier bridge then changes this alternating current to direct current which appears at the output terminal. A diode trio also is connected to the stator windings to supply current to the regulator and the rotor field during operation.

Voltage output of the alternator is controlled by regulating the current supplied to the rotor field. This is accomplished by a transistorized voltage regulator that senses the voltage at the battery and regulates the field current to maintain alternator voltage within prescribed limits for properly charging the battery. Current output of the alternator does not require regulation, as maximum current output is self-limited by the design of the alternator. As long as the voltage is regulated within the prescribed limits, the alternator cannot produce excessive current. A cutout relay in the voltage regulator also is not required, as the rectifier diodes (which allow current to flow in one direction only) prevent the battery from discharging back through the stator.

Due to the lack of residual magnetism in the rotor pole pieces, a small amount of current must be supplied to the rotor field to initially start the alternator charging. This is accomplished by means of an excitation circuit in the regulator which is connected to the ignition switch. Once the alternator begins to produce output, field current is supplied solely by the diode trio, as explained, preceding.

The alternator also is equipped with a fan (mounted on the rotor shaft) which induces air flow through the alternator to remove the heat created by the rectifier and stator. A capacitor also is utilized to protect the rectifier system from high voltages and to suppress radio noise.

Precautions

The following precautions MUST BE observed when working on the alternator system. Failure to observe these precautions may result in serious damage to the alternator or alternator system.

1. DO NOT attempt to polarize the alternator.
2. DO NOT short across or ground any of the terminals on the alternator, except as specifically instructed in the "Troubleshooting Tests."
3. NEVER disconnect the alternator output lead or battery cables when the alternator is being driven by the engine.
4. NEVER disconnect regulator lead from alternator regulator terminal when the alternator is being driven by the engine.
5. ALWAYS remove negative (-) battery cable from battery before working on alternator system.
6. When installing battery, BE SURE to connect the negative (-) (grounded) battery cable to negative (-) battery terminal and the positive (+) battery cable to positive (+) battery terminal.
7. If a charger or booster battery is to be used. BE SURE to connect it in parallel with existing battery (positive to positive; negative to negative).

Periodic Maintenance

The following maintenance check should be performed every 50 hours or 60 days (whichever comes first) in fresh water areas or every 25 hours or 30 days in salt water areas.

⚠CAUTION
Remove all battery cables from battery (before conducting the following check) to prevent accidentally shorting out electrical system.

1. Inspect entire alternator system for corroded or loose connections.
2. Check wiring for frayed or worn insulation.
3. Check alternator drive belt for excessive wear, cracks, fraying and glazed surfaces. Also, check drive belt tension and adjust, if necessary, as explained under "Drive Belt Tension Adjustment."
4. Check alternator mounting bolts for adequate tightness.
5. Inspect slip ring end frame flame arrestor screen for debris and clean, if necessary, using compressed air or a cloth. Screen MUST BE clean, or alternator may overheat.

Troubleshooting Tests (Alternator on Engine)

Use the following tests in conjunction with the "Troubleshooting" in Section 1. Before proceeding with the tests, however, perform the following checks to eliminate possible problem areas. Also observe "Precautions," immediately preceding, to prevent damage to alternator system.

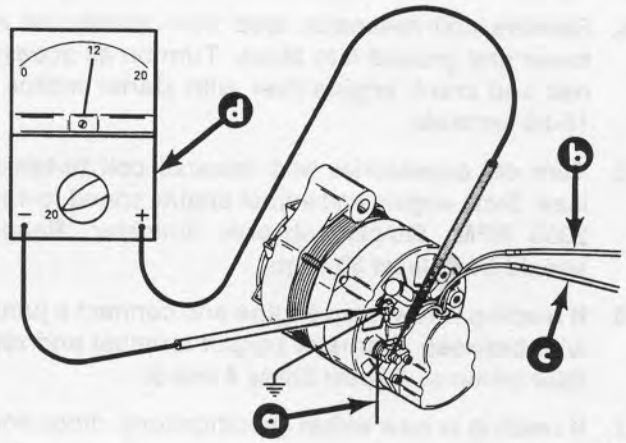
1. If problem is an undercharged battery, check to ensure that undercharged condition has not been caused by excessive accessory current draw or by accessories which have accidentally been left on. Also, check that undercharged condition has not been caused by running engine at too low a speed for extended periods of time.
2. Check physical condition and state of charge of battery, as outlined in "Storage Battery" in "Section 4 Part A." Battery MUST BE at least 75% (1.230 specific gravity) of fully charged to obtain valid results in the following tests. If not, charge battery before testing system.
3. Inspect entire alternator system wiring for defects. Check all connections for tightness and cleanliness, particularly battery cable clamps and battery terminals.
4. Check alternator drive belt for excessive wear, cracks, fraying and glazed surfaces and replace if necessary. Also, check drive belt tension and adjust if necessary, as outlined under "Drive Belt Replacement and Tension Adjustment."

Circuitry Test

Perform the following tests, using a 0-20 volt DC voltmeter, to check that all of the circuits between the alternator and the other components within the alternator system are in good condition.

OUTPUT CIRCUIT

1. Connect positive voltmeter lead to alternator output terminal and negative lead to a ground terminal on alternator.
2. Wiggle engine wiring harness while observing voltmeter. Meter should indicate approximately battery voltage and should not vary. If no reading is obtained, or if reading varies, check alternator output circuit for loose or dirty connections or damaged wiring.



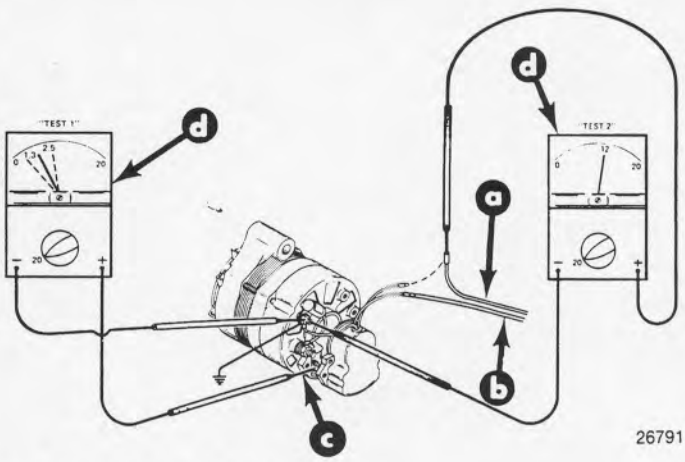
26785

a - Output Wire - Orange
b - Excitation Wire - Purple
c - Sensing Wire - Red/Purple
d - Volt Meter (0-20 Volts)

Alternator Output Circuit Test

EXCITATION CIRCUIT

1. Remove 4 screws which secure the regulator to the alternator.
2. Connect positive (+) voltmeter lead to regulator terminal (green wire) on alternator and negative (-) lead to a ground terminal on alternator. (Test No. 1)
3. Turn ignition switch to "On" position and note voltmeter reading. Reading should be 1.3 to 2.5 volts.
4. If no reading is obtained, an opening exists in alternator excitation lead or in excitation circuit of regulator. Unplug purple lead from regulator. Connect positive voltmeter lead to purple lead and negative voltmeter lead to ground. (Test No. 2) If voltmeter now indicates approximate battery voltage, voltage regulator is defective and must be replaced. If no voltage is indicated, check excitation circuit for loose or dirty connections or damaged wiring.
5. If reading is between .75 and 1.1 volts, rotor field circuit probably is shorted or grounded. Disassemble alternator and test rotor as outlined under "Alternator Repair," following.
6. If reading is between 6.0 and 7.0 volts, rotor field circuit probably is open. Remove regulator and inspect for worn brushes or dirty slip rings. Replace brushes if less than 1/4 in. (6mm) long. If brushes and slip rings are in good condition, disassemble alternator and test rotor, as outlined under "Alternator Repair."



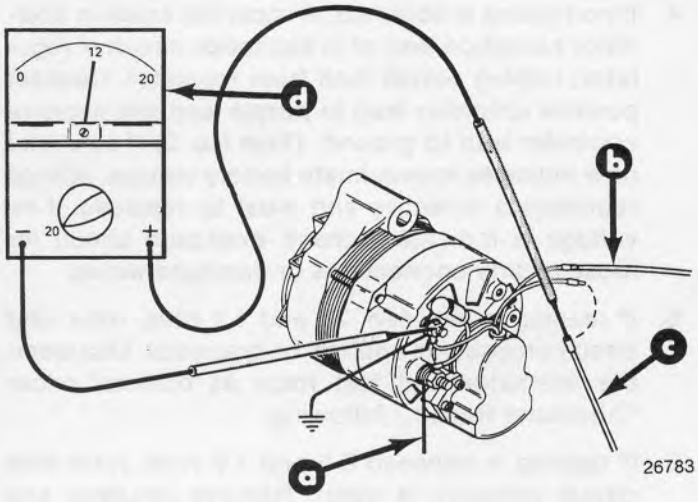
26791

a - Excitation Wire - Purple
b - Sensing Wire - Red/Purple
c - Green Wire
d - Voltmeter (0-20 Volts)

Alternator Excitation Circuit Test

SENSING CIRCUIT

1. Unplug red/purple lead from voltage regulator.
2. Connect positive voltmeter lead to red/purple lead and negative voltmeter lead to ground terminal.
3. Voltmeter should indicate battery voltage. If battery voltage is not present, check sensing circuit (red/purple lead) for loose or dirty connection or damaged wiring.



a - Output Wire - Orange
b - Excitation Wire - Purple
c - Sensing Wire - Red-Purple
d - Volt Meter (0-20 Volts)

Regulator Sensing Circuit Test

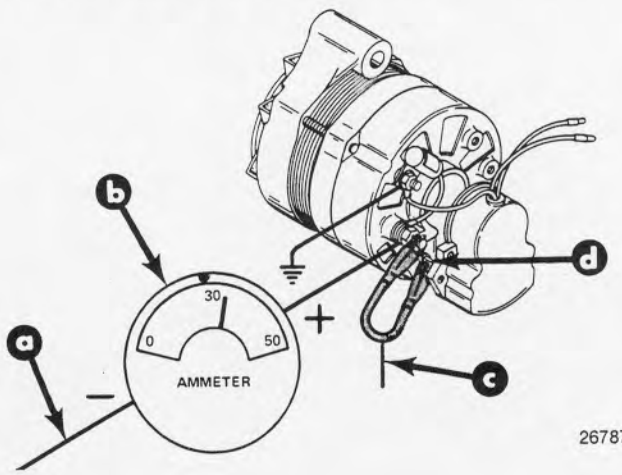
Current Output Test

Perform this test to check if alternator is capable of producing rated current output, using a 0-50 amp DC ammeter.

⚠WARNING

Be sure that engine compartment is well-ventilated and that there are no gasoline vapors present (during the test) to prevent the possibility of an explosion and/or a fire, should a spark occur.

1. Disconnect negative (-) battery cable from battery.
2. Disconnect orange lead from alternator output terminal and connect ammeter in series between lead and output terminal. Connect positive (+) side of ammeter toward output terminal.
3. Reconnect negative battery cable.
4. Remove coil hi-tension lead from distributor cap tower and ground it to block. Turn on all accessories and crank engine over with starter motor for 15-20 seconds.
5. Turn off accessories and reinstall coil hi-tension lead. Start engine and adjust engine speed to 1500-2000 RPM. Quickly observe ammeter. Reading should be at least 30 amps.
6. If reading is low, stop engine and connect a jumper wire between alternator output terminal and regulator terminal. Repeat Steps 4 and 5.
7. If reading is now within specifications, diode trio is faulty. Disassemble alternator and replace diode trio, as explained under "Alternator Repair," following.
8. If reading is still low with jumper wire connected, perform "Voltage Regulator Test," following, to determine if fault is in regulator or alternator.



a - Output Wire - Orange
b - Ammeter (0-50 Amps)
c - Jumper Lead
d - Regulator Terminal (Green Wire)

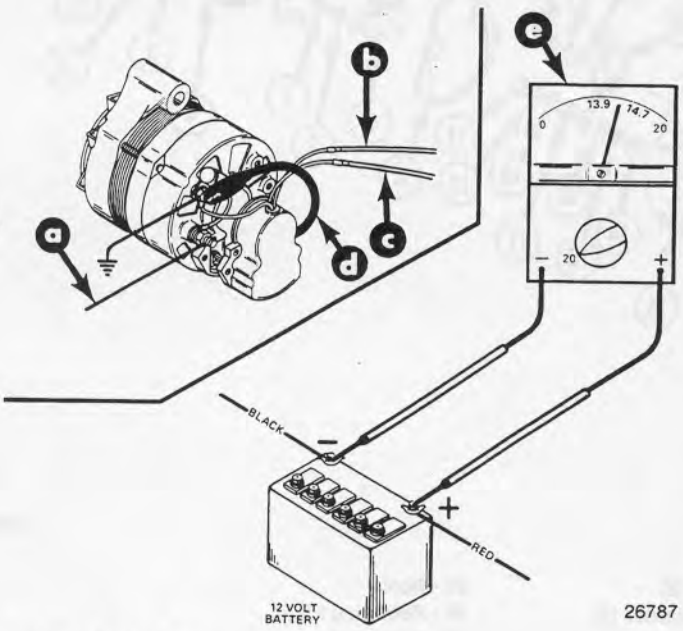
Alternator Current Output Test

Voltage Output Test

Perform this test to determine if voltage regulator is operating correctly, using a 0-20 volt DC voltmeter.

IMPORTANT: Battery MUST BE fully charged (1.260 or above specific gravity) to obtain proper voltage reading in this test. If necessary, charge battery with a battery charger or allow engine to run a sufficient length of time to fully charge battery before taking reading.

1. Connect positive (+) voltmeter lead to positive battery terminal and negative (-) voltmeter lead to negative terminal.
2. Start engine and run at fast idle until engine reaches normal operating temperature. Adjust engine speed to 1500-2000 RPM and observe voltmeter for highest reading. Reading should be between 13.9 and 14.7 volts.
3. If reading is high, check for a loose or dirty regulator ground lead connection. If connection is good (and sensing circuit checked out good in "Alternator System Circuitry Test"), voltage regulator is faulty and must be replaced. Be sure to disconnect battery cables before attempting to remove regulator.



a - Output Wire - Orange
b - Excitation Wire - Purple
c - Sensing Wire - Red/Purple
d - Jumper Lead (To Tan Wire and Ground)
e - Voltmeter (0-20 Volts)

Voltage Regulator Test

⚠WARNING
Be sure that engine compartment is well-ventilated and that there are no gasoline vapors present (during the next steps) to prevent the possibility of an explosion and/or fire, should a spark occur.

⚠CAUTION
DO NOT allow jumper wire to contact alternator end frame (in next step), as diode trio and regulator may be damaged.

4. If reading is low, stop engine and remove 4 regulator attaching screws. Pull regulator away from alternator end frame to gain access to field terminal. DO NOT disconnect regulator terminals. Connect a jumper lead from the ground stud to the brush terminal that has a tan wire attached. Restart engine and gradually increase engine speed to 1500 RPM while observing voltmeter. DO NOT allow voltage to exceed 16 volts.
5. If a voltmeter reading of 14.5 volts or above is now obtained, voltage regulator is faulty and must be replaced. If voltmeter reading is below 14.5 volts, inspect brushes and slip rings for wear, dirt or damage. If brushes and slip rings are good, alternator is faulty internally. Disassemble alternator and test components, as outlined under "Alternator Repair," following.

Alternator Repair

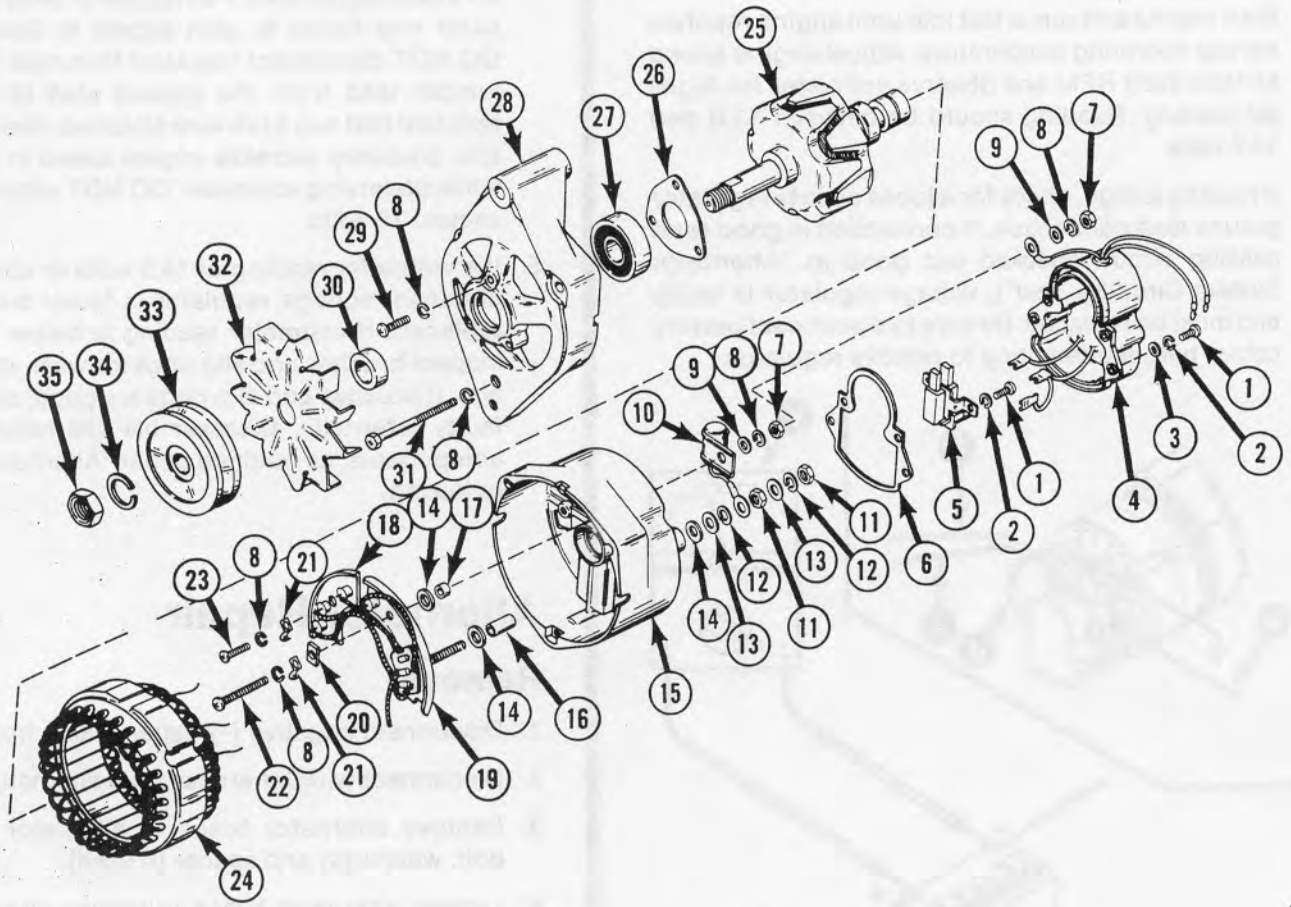
Removal

1. Disconnect negative (-) battery cable from battery.
2. Disconnect wiring harness from alternator.
3. Remove alternator brace to alternator attaching bolt, washer(s) and spacer (if used).
4. Loosen alternator brace to engine attaching bolt and alternator mounting bolt, then pivot alternator inward and remove alternator drive belt.
5. Remove alternator mounting bolt, washers (if used), spacer and nut and remove alternator.

Disassembly

IMPORTANT: The following instructions are for complete disassembly and overhaul of the alternator. In many cases, however, complete disassembly of alternator is not required and, in those cases, it is necessary only to perform the operations required to repair or replace the faulty part.

1. Mount alternator in a vise so that rear end frame is facing you.
2. Disconnect regulator leads from terminals on rear end frame. Remove 4 regulator attaching screws, then pull regulator away from rear end frame and disconnect regulator field leads. Remove regulator rubber seal.
3. Remove 2 brush set attaching screws and remove brush set.



26782

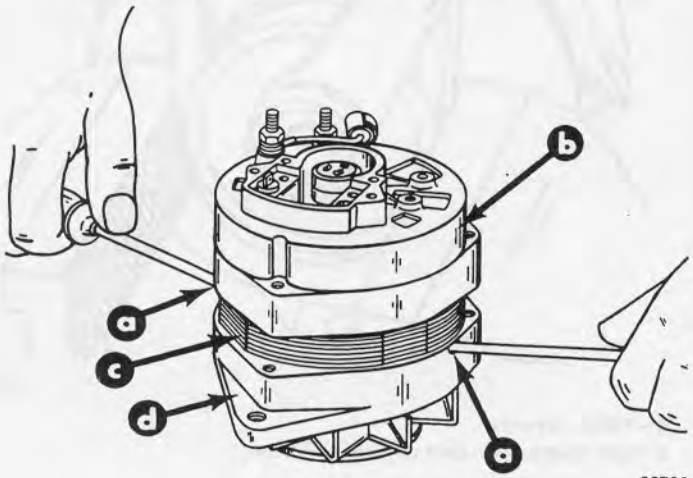
1 - Screw (6)
2 - Lockwasher (6)
3 - Flatwasher (4)
4 - Regulator
5 - Brush Set
6 - Rubber Seal
7 - Nut
8 - Lockwasher (6)
9 - Flatwasher (2)
10 - Condenser
11 - Nut
12 - Lockwasher (2)
13 - Flatwasher (2)
14 - Insulating Washer (3)
15 - End Frame
16 - Insulating Sleeve - Long
17 - Insulating Sleeve - Short
18 - Negative (-) Rectifier
19 - Positive (+) Rectifier
20 - Insulator - Rectangular
21 - Clip (2)
22 - Screw (1)
23 - Screw (2)
24 - Stator
25 - Rotor
26 - Retaining Plate
27 - Front Bearing
28 - End Frame
29 - Screw (3)
30 - Spacer
31 - Screw (3)
32 - Fan
33 - Pulley
34 - Lockwasher
35 - Nut

Mando Alternator Parts View

4. Scribe a mark on rear end frame, stator and front end frame to ensure proper reassembly later.
5. Remove 3 screws which secure end frames and stator together.

IMPORTANT: DO NOT insert screwdriver blades more than 1/16 in. (1.5mm) into openings (in next step), as stator windings may be damaged.

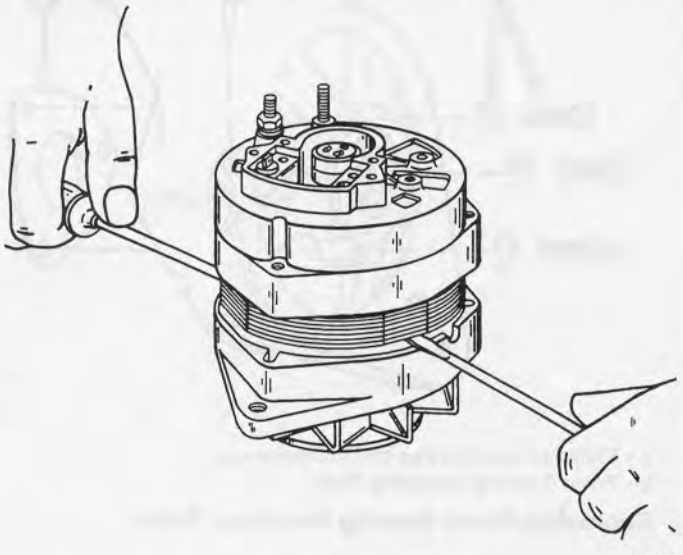
6. Separate rear end frame and stator assembly from front end frame and rotor assembly using 2 thin blade screwdrivers (positioned at 180° apart from one another) at the location shown. Use the two slots, shown to initially separate units.



26792

a - DO NOT Insert Screwdriver Blades More than 1/16 in. (1.5mm) into Slots
b - Rear End Frame
c - Stator
d - Front End Frame

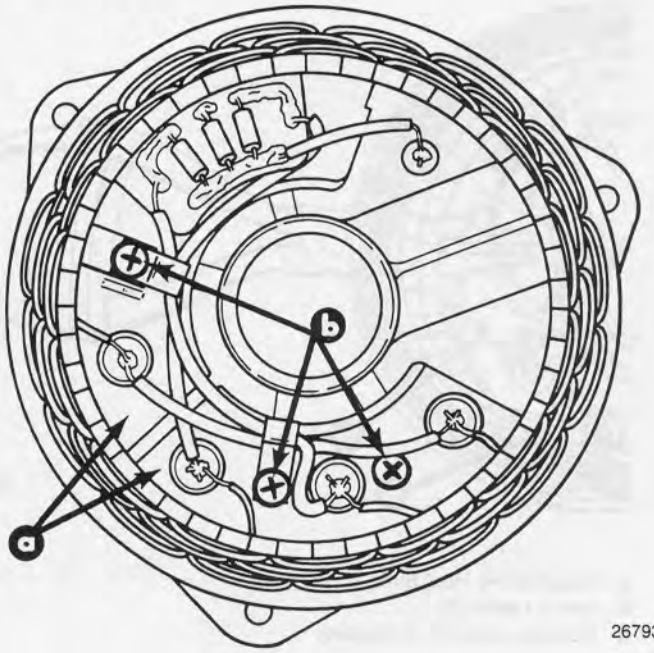
Separating Rear End Frame and Stator Assembly from Front End Frame and Rotor Assembly



26792

Separating Rear End Frame and Stator Assembly from Front End Frame and Rotor Assembly

7. Place rear end frame and stator assembly on the bench with stator downward. Be sure that bench is clean and free of metal chips. Remove nuts, washers, insulators and condenser from output and ground studs.
8. Turn end frame over (stator upward) and remove the three phillips head screws which secure rectifiers to end frame.

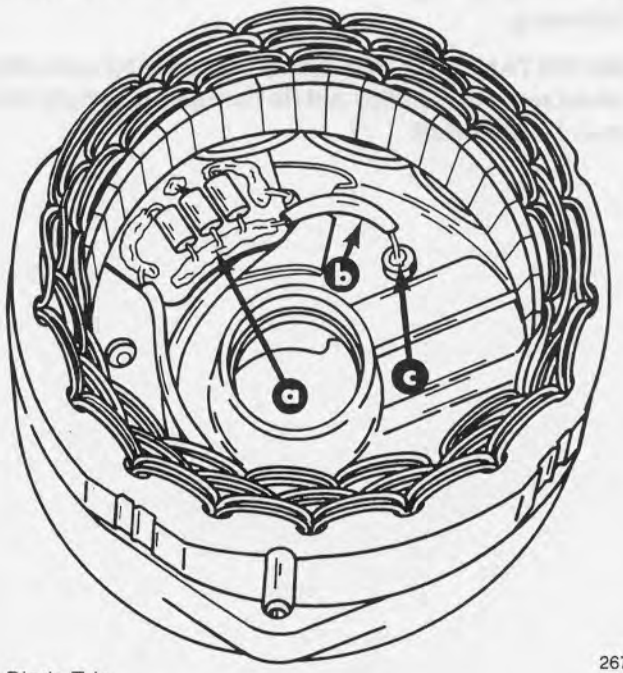


26793

a - Rectifiers
b - Phillip Head Screws

Removing Rectifiers

9. Unsolder diode trio lead from insulated regulator terminal.

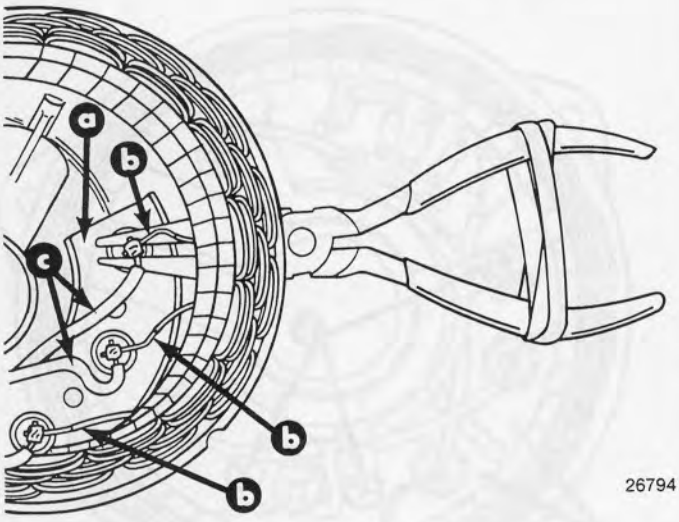


26793

a - Diode Trio
b - Diode Trio Lead
c - Insulated Terminal

Diode Trio Lead Removal

10. Unsolder the three (3) stator leads along with the three (3) coated leads from the negative (-) rectifier heat sink. Place a needle nose pliers on diode terminal between solder joint and diode body to help prevent heat damage to diodes. Unsolder joints as quickly as possible and allow diode terminal to cool before removing pliers.



26794

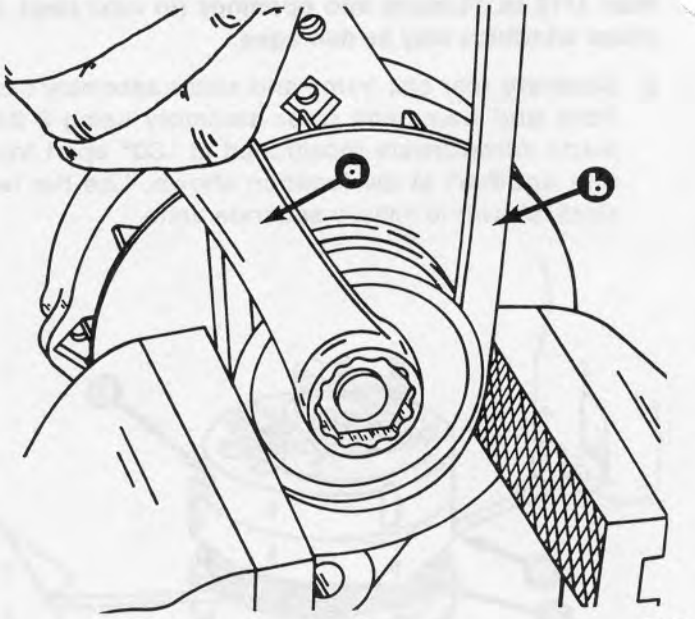
a - Negative (-) Heat Sink
b - Stator Leads (3)
c - Coated Leads (3) (2 Shown)

Unsoldering Leads from Negative (-) Rectifier Heat Sink

IMPORTANT: With alternator disassembled to this point, stator, rectifier diodes, diode trio and rotor may be tested, as explained under "Component Testing," following.

IMPORTANT: DO NOT clamp vise on rotor pole pieces when removing pulley nut (in next step), as pole pieces may be distorted.

11. Remove pulley retaining nut by clamping pulley in a vise (using an oversize V-belt or protective jaws to protect pulley) and turning nut counterclockwise with a 7/8 in. wrench. Remove lockwasher and slide pulley and fan from shaft. If pulley is "stubborn," it may be necessary to use an universal pullers.

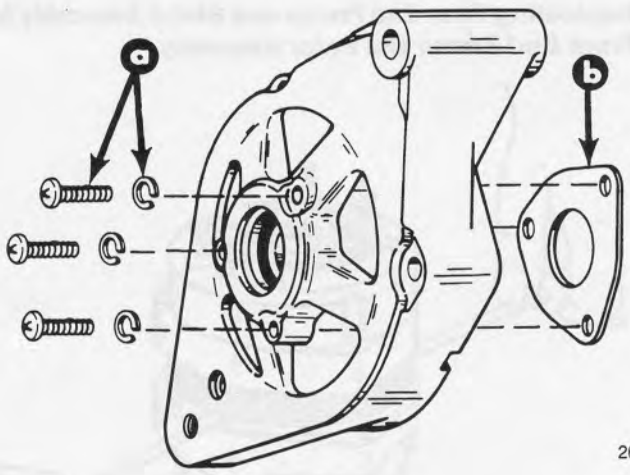


26794

a - 7/8 in. Wrench
b - Use Oversize V-Belt to Protect Pulley

Removing Pulley Nut

12. Remove the (3) phillips head screws and lock washers which secure the front bearing retaining plate.



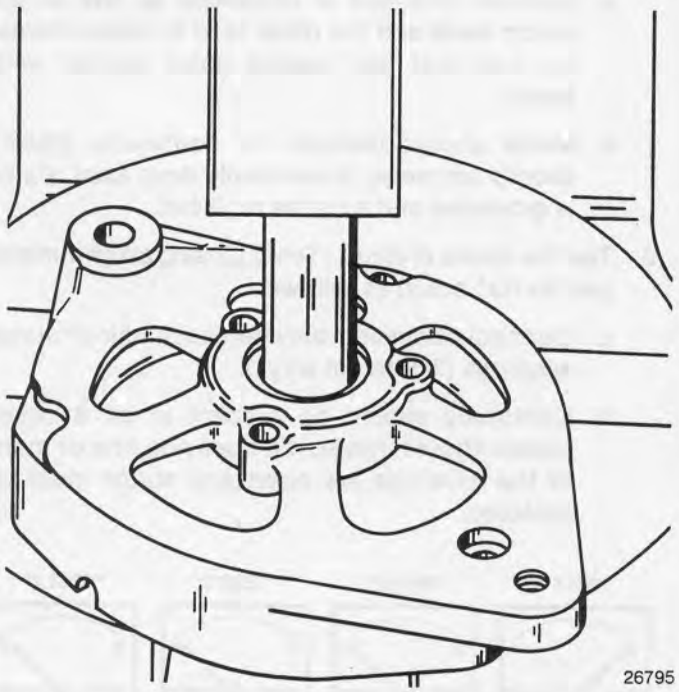
26786

a - Phillips Head Screws and Lockwashers
b - Front Bearing Retaining Plate

Removing Front Bearing Retaining Plate

13. Remove front bearing from front end frame using an arbor press and a suitable size mandrel. (Discard bearing.)

14. If rotor slip rings or rear bearing require replacement, entire rotor must be replaced. Parts cannot be purchased separately.



Removing Front Bearing from Front End Frame

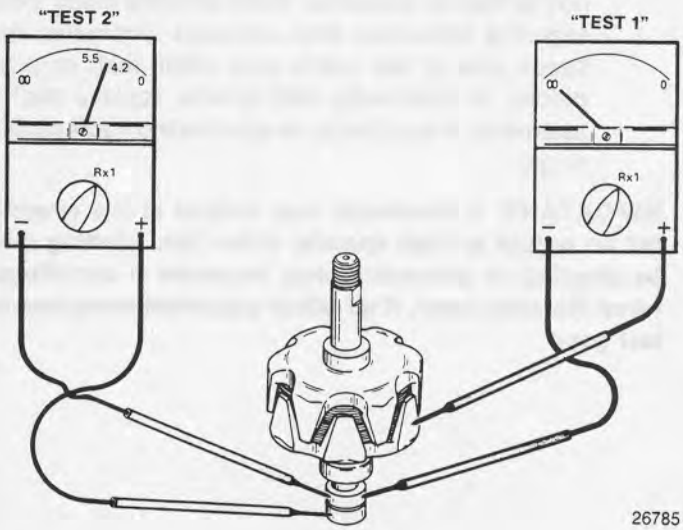
Cleaning and Inspection

1. Clean all parts with a clean, soft cloth. DO NOT use solvent, or electrical components may be damaged.
2. Inspect the following parts for wear and damage:
   a. **Brush set** - inspect for cracked porcelain casing, damaged brush leads, poor brush lead solder connections, weak or broken brush springs or worn brushes. Replace brush set if brushes are less than 1/4 in. (6mm) long.
   b. **Rotor** - inspect for stripped threads, scuffed pole piece fingers or damaged bearing surfaces (because of bearing turning on shaft).
   c. **Rotor slip rings** - clean slip rings with 400 grain (or finer) polishing cloth while spinning rotor in a lathe. Blow off dust with compressed air. Inspect slip rings for grooves, pits, flat spots or out-of-round [.002 in. (0.051mm) maximum] and replace, if present.
   d. **Rotor shaft bearings** - inspect for damaged seals, lack of lubrication, discoloration (from overheating) or excessive side or end play. Hold inner race of bearings while turning outer race. Bearing should turn freely without binding or evidence of rough spots.
   e. **Stator** - inspect for damaged insulation or wires; also inspect insulating enamel for heat discoloration, as this is usually a sign of a shorted or grounded winding or a shorted diode.
   f. **Regulator** - inspect leads for damaged insulation.
   g. **Front and rear end frames** - inspect for cracks, distortion, stripped threads or wear in bearing bore (from bearing outer race spinning in bore). End frame(s) MUST BE replaced, if bearing has spun. Also, inspect bearing retainer recess in front end frame for damage.
   h. **Fan** - inspect for cracked or bent fins, broken welds (bi-rotational fan only) or worn mounting hole (from fan spinning on shaft).
   i. **Pulley** - inspect pulley mounting bore end for wear. Inspect drive surface of pulley sheaves for trueness, excessive wear, grooves, pits, nicks or corrosion. Repair damaged surfaces, if possible, with a fine file and a wire brush or replace pulley, if beyond repair. Drive surfaces MUST BE perfectly true and smooth, or drive belt wear will be greatly accelerated.

Component Testing

ROTOR

1. Test rotor field circuit for opens, shorts or high resistance (Test 1), using an ohmmeter (set on Rx1 scale), as follows:



Testing Rotor Field Circuit

   a. Connect one ohmmeter lead to each slip ring.
   b. Ohmmeter reading should be 4.2 to 5.5 ohms with rotor at room temperature 70° - 80° F (21° - 26° C).

c. If reading is high or infinite (no meter movement), high resistance or an open exists in the field circuit. Check for poor connections between field winding leads and slip ring terminals. If cause for open or high resistance cannot be found, connect ohmmeter directly to slip ring terminals. If correct reading is now obtained, or if reading is still high or infinite, replace complete rotor assembly.

d. If reading is low, a short exists in the field circuit. Inspect slip rings to be sure that they are not bent and touching outer slip ring. Also be sure that excess solder is not shorting terminals to aft slip ring. If cause for short cannot be found, unsolder field winding leads from slip ring terminals and connect ohmmeter directly to leads. If correct reading is now obtained, or if reading is still low, slip rings and rotor field windings are shorted, and complete rotor assembly must be replaced.

2. Test rotor field circuit for grounds (Test 2), using an ohmmeter (set on Rx1 scale) as follows:

   a. Connect one lead of ohmmeter to either slip ring and the other lead to rotor shaft or pole pieces.

   b. Meter should indicate no continuity (meter should not move).

   c. If continuity does exist, rotor field circuit is grounded. Inspect slip ring terminals to be sure that they are not bent and touching rotor shaft. Also be sure that excess solder is not grounding terminals to rotor shaft. If cause for ground cannot be found, unsolder field winding leads from slip ring terminals and connect ohmmeter between one of the leads and rotor shaft or pole pieces. If continuity still exists, replace motor assembly. If continuity is eliminated, replace slip rings.

IMPORTANT: If alternator has output at low speeds, but no output at high speeds, rotor field winding may be shorting or grounding out, because of centrifugal force. Replace rotor, if all other electrical components test good.

STATOR

IMPORTANT: Stator leads MUST BE disconnected from rectifier diodes and diode trio for this test.

1. Test stator for grounds (Test 1), using an ohmmeter (set on Rx1 scale) as follows:

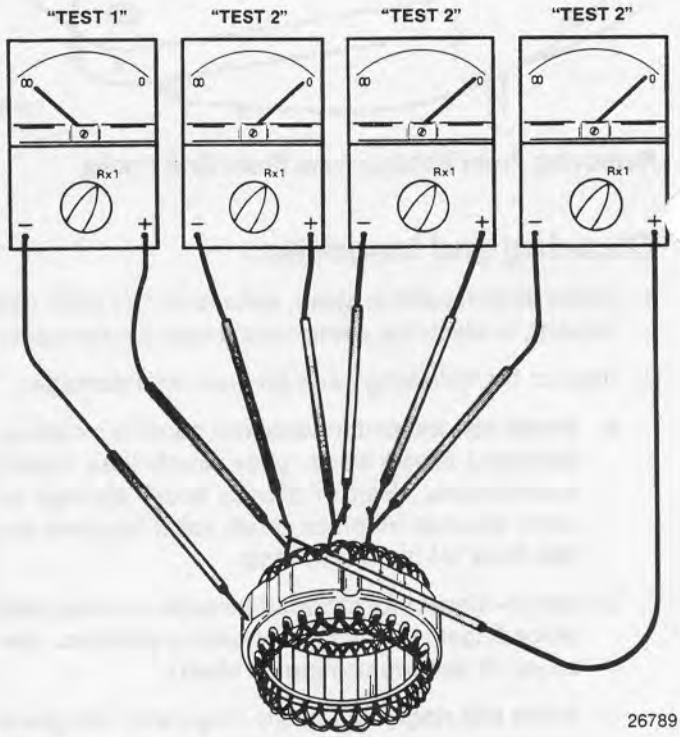
   a. Connect one lead of ohmmeter to one of the stator leads and the other lead to stator frame. Be sure that lead makes good contact with frame.

   b. Meter should indicate no continuity (meter should not move). If continuity does exist, stator is grounded and must be replaced.

2. Test for opens in stator (Test 2), using an ohmmeter (set on Rx1 scale) as follows:

   a. Connect ohmmeter between each pair of stator windings (3 different ways).

   b. Continuity should be present in all 3 cases (meter should move). If it does not, one or more of the windings are open and stator must be replaced.



Testing Stator

3. A short in the stator is difficult to detect without special equipment, because of the low windings resistance. If all other electrical components test out good, and alternator fails to produce rated output, stator probably is shorted and should be replaced. Also, examine stator for heat discoloration, as this usually is a sure sign of a short.

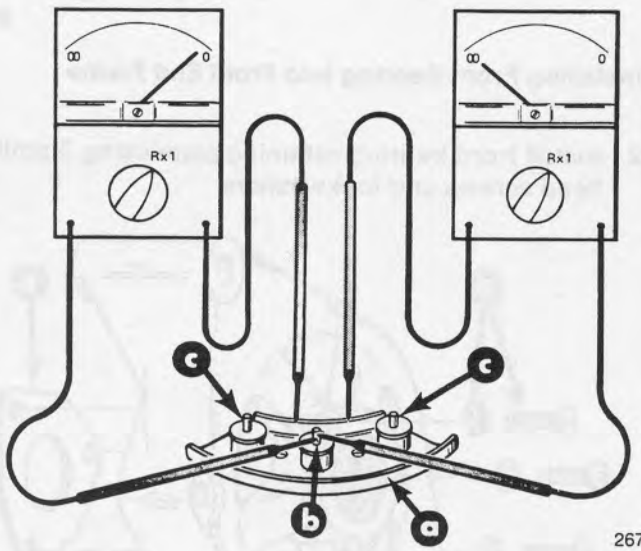
NEGATIVE (-) RECTIFIER DIODES

IMPORTANT: Rectifier diodes MUST BE disconnected from stator for this test.

⚠CAUTION

DO NOT use a test instrument with more than a 12-volt source (in the following test), as rectifier diodes may be damaged.

1. Connect one lead of an ohmmeter (set on Rx1 scale) to negative (-) rectifier diode heat sink and the other lead to one of the rectifier diode terminals. Note the reading.
2. Reverse leads and again note reading.
3. Meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading when connected the other. If both readings are high or infinite, diode is open. If both readings are low, diode is shorted.
4. Repeat Steps 1-thru-3 for 2 other rectifier diodes in heat sink.
5. Replace complete rectifier set, if any of the diodes is shorted or open.



26784

a - Heat Sink
b - Diode Terminal
c - Test These 2 Diodes in Same Manner

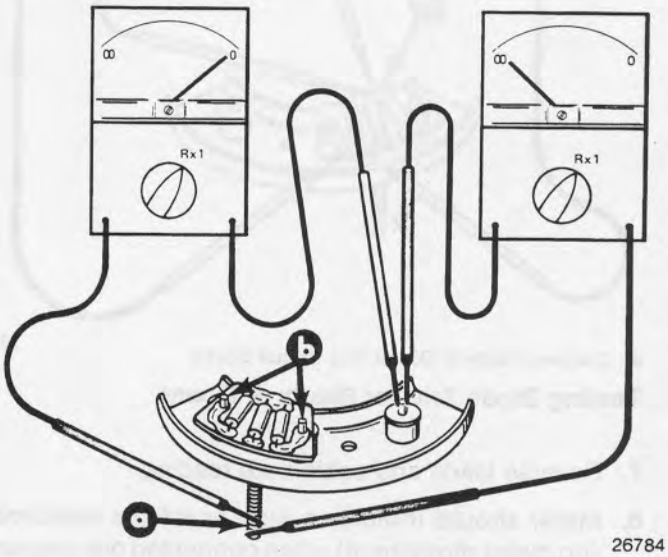
Testing Negative (-) Rectifier Diodes for Shorts or Opens

⚠CAUTION

DO NOT use a test instrument with more than a 12-volt source (in the following test), as rectifier diodes may be damaged.

POSITIVE (+) RECTIFIER DIODES and DIODE TRIO

1. Connect one lead of an ohmmeter (set on Rx1 scale) to 1/4 in. stud on positive (+) rectifier heat sink and the other lead to one of the rectifier diode terminals. (Note: Two of the diode terminals come up thru the diode trio circuit board.) Note the meter reading.
2. Reverse leads and again note reading.
3. Meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading when connected the other. If both readings are high or infinite, diode is open. If both readings are low, diode is shorted.
4. Repeat Steps 1-thru-3 for 2 other rectifier diodes in heat sink.

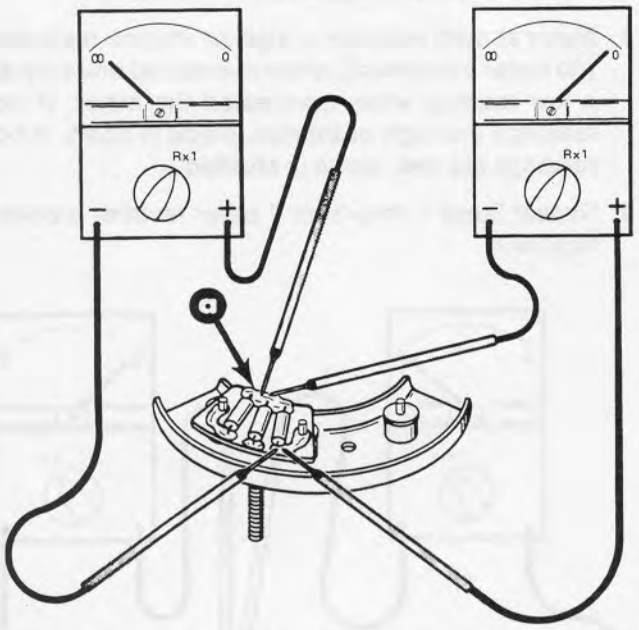


26784

a - Stud
b - Repeat Test between These Terminals and Stud

Testing Positive (+) Rectifier Diodes for Shorts or Opens

5. Replace complete rectifier set, if any one of the diodes is shorted or open.
6. Connect one lead of an ohmmeter (set on Rx1 scale) to the common side on the diode trio circuit board and the other lead to the other side of one of the three (3) trio diodes.



a - Common Side of Diode Trio Circuit Board

Testing Diode Trio for Shorts or Opens

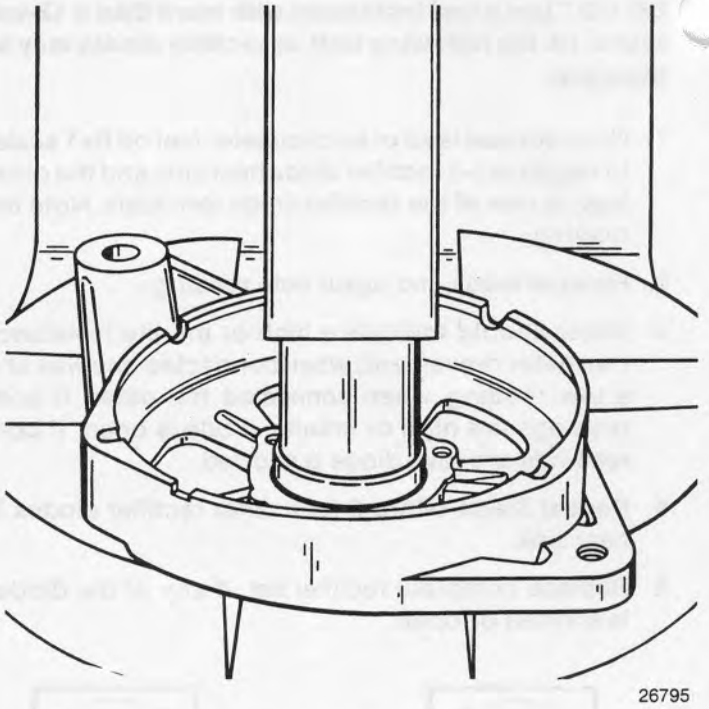
7. Reverse leads and again note reading.
8. Meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading when connected the other. If both readings are high or infinite, diode trio is open. If both readings are low, diode trio is shorted.
9. Repeat Steps 6-thru-8 for the other 2 diodes.
10. Replace positive (+) rectifier and diode trio assembly if any one of the diodes is shorted or open.

CONDENSER

1. Using Magneto Analyzer and accompanying instructions, perform the following condenser tests:
   a. Condenser Capacity Test (must be .5 mfd).
   b. Condenser Short or Leakage Test.
   c. Condenser Series Resistance Test.
2. Replace condenser, if test results are not within specifications.

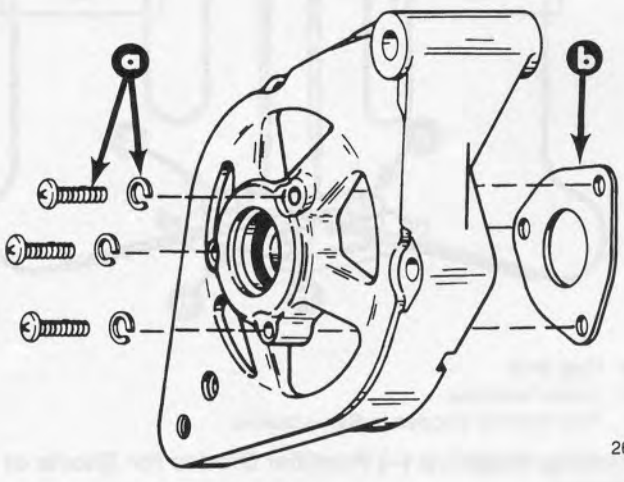
Reassembly

1. Install new front bearing into front end frame bearing bore using an arbor press. If necessary, use a bearing driver that contacts outer race only.



Installing Front Bearing into Front End Frame

2. Install front bearing retaining plate using 3 phillip head screws and lockwashers.



a - Phillips Head Screws and Lockwashers
b - Front Bearing Retaining Plate

Installing Front Bearing Retaining Plate

3. Slide front end frame over rotor.

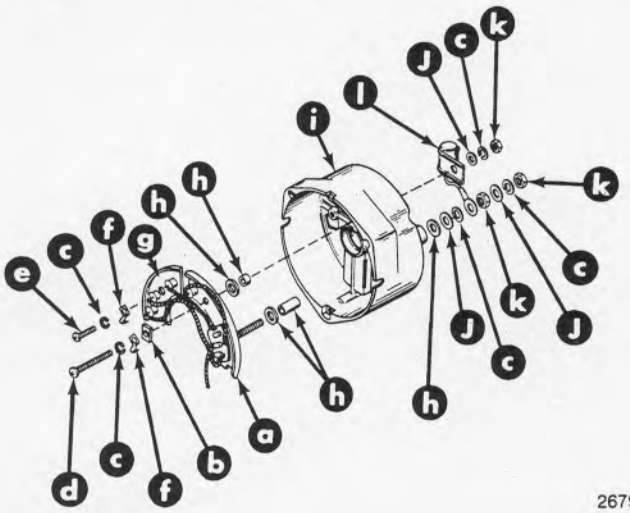
IMPORTANT: DO NOT clamp vise on rotor pole pieces when tightening pulley nut (in next step), or pole pieces may be distorted.

4. Slide fan spacer onto rotor shaft. Install fan, pulley, lockwasher and nut on shaft. Clamp pulley in a vise, using protective jaws or an old oversize V-belt to protect pulley, and torque nut to specifications. Tighten vise only enough to allow tightening of nut, as excessive tightening may distort pulley.

IMPORTANT: The insulating washers MUST BE installed as shown or damage to the alternator WILL result.

5. Install positive (+) and negative (-) rectifier heat sinks, shown.

6. Position rear end frame and stator assembly over front end frame and rotor assembly and align scribe marks on each (scribed during assembly). Hand-press end frames together, then install screws. Tighten screws securely.



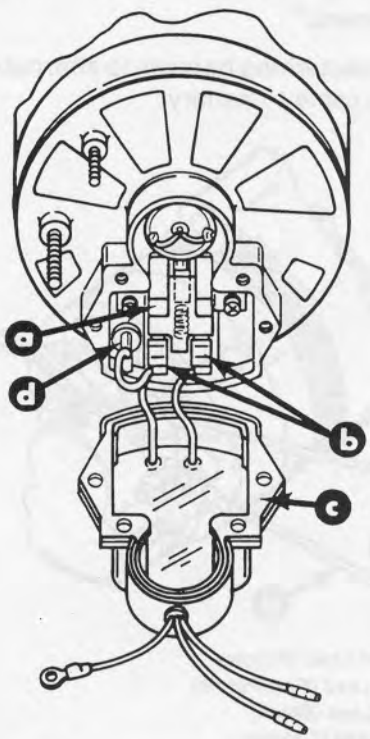
26790

a - Positive (+) Rectifier Heat Sink
b - Rectangular Insulator
c - Lockwasher
d - Screw - 1-1/2 in. (38mm) Long
e - Screw - 1/2 in. (13mm) Long; 2 Required
f - Clip
g - Negative (-) Rectifier Heat Sink
h - Insulator
i - Rear End Frame
j - Flat Washer
k - Nut
l - Condenser

Installing Positive (+) and Negative (-) Rectifier Heat Sinks

7. Place brush set in rear end frame cavity and secure with 2 mounting screws, as shown. Be sure to use outermost mounting holes. Tighten screws securely.

8. Position rubber seal on regulator mounting surface. Connect regulator field leads and regulator lead to brush and regulator terminals (shown), then mount regulator with 4 screws. Connect ground terminal and secure with lockwashers and nuts. Tighten screws and nuts securely.



26789

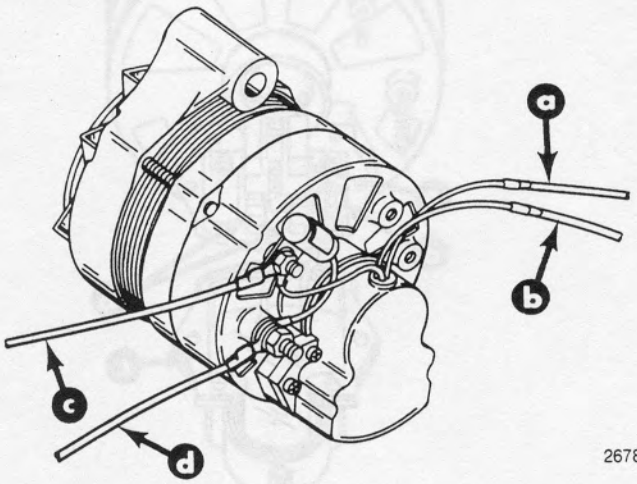
a - Brush Set (Use Outer Mounting Holes)
b - Be Sure to Connect Field Leads as Shown
c - Regulator Rubber Seal
d - Insulated Regulator Terminal

Installing Brush Set and Regulator

IMPORTANT: Regulator field leads MUST BE connected as shown, or leads may be damaged by rotor slip rings during operation.

Installation

1. Position alternator in mounting bracket and install mounting bolt, washers (if used), spacer and nut. Place washers (if used), on each side of spacer. DO NOT tighten securely at this time.
2. Fasten alternator brace to alternator with bolt, washers and spacer (if used). DO NOT tighten bolt at this time.
3. Position alternator drive belt on pulleys and adjust tension as explained under "Drive Belt Tension Adjustment."
4. Reconnect wiring harness to alternator and negative battery cable to battery.



26786

a - Excitation Lead (Purple)
b - Sensing Lead (Red/Purple)
c - Ground Lead (Black)
d - Output Lead (Orange)

Wiring Harness Connected to Alternator

Prestolite (Motorola) Alternator

Specifications

Voltage Output	13.8 - 14.8 Volts
Current Output	51 Amps
Excitation Circuit	1.5 - 3.0 Volts
Condenser Capacity	.5 mfd
Minimum Brush Length	3/16 in. (5mm)

Special Tools

Multi-Meter/DVA Tester	91-99750
Magneto Analyzer	91-76032

TOOLS PURCHASED LOCALLY

Ammeter (0-50 Amps)

Torque Specifications

Housing Screws	50-60 lb. in. (6 N·m)
Pulley Nut	35-50 lb. ft. (48-68 N·m)
Front Bearing Screws	25-35 lb. in. (3 N·m)
Alternator Mount	35 lb. ft. (48 N·m)
Adjustment Bolt	16 lb. ft. (28 N·m)
Tighten All Other Fasteners Securely	

Sealants

Liquid Neoprene	92-25711
Heat Sink Compound — Obtain Locally	

Description

The alternator employs a rotor, which is supported in 2 end frames by ball bearings, and is driven (via a pulley) at approximately twice engine speed. The rotor contains a field winding that is enclosed between 2 multiple-finger pole pieces. The ends of the field windings are connected to 2 brushes (mounted in the rear end frame) which make continuous sliding (or slipping) contact with the slip rings. The current (flowing through the field winding) creates a magnetic field that causes the adjacent fingers of the pole pieces to become alternate north and south magnetic poles.

A 3-phase stator is mounted directly over the rotor pole pieces and between the 2 end frames. It consists of 3 windings wound 120° electrically out-of-phase on the inside of a laminated core. The windings are all connected together on one end, while the other ends are connected to a full-wave rectifier bridge.

The rectifier bridge contains 6 diodes which are arranged so that current flows from ground, thru the stator and to the output terminal, but not in the opposite direction.

When current is supplied to the rotor field winding, and the rotor is turned, the movement of the magnetic fields created induces an alternating current into the stator windings. The rectifier bridge then changes this alternating current to direct current which appears at the output terminal. A diode trio also is connected to the stator windings to supply current to the regulator and the rotor field during operation.

Voltage output of the alternator is controlled by regulating the current supplied to the rotor field. This is accomplished by a transistorized voltage regulator that senses the voltage at the battery and regulates the field current to maintain alternator voltage within prescribed limits for properly charging the battery. Current output of the alternator does not require regulation, as maximum current output is self-limited by the design of the alternator. As long as the voltage is regulated within the prescribed limits, the alternator cannot produce excessive current. A cutout relay in the voltage regulator also is not required, as the rectifier diodes (which allow current to flow in one direction only) prevent the battery from discharging back through the stator.

Due to the lack of residual magnetism in the rotor pole pieces, a small amount of current must be supplied to the rotor field to initially start the alternator charging. This is accomplished by means of an excitation circuit in the regulator which is connected to the ignition switch. Once the alternator begins to produce output, field current is supplied solely by the diode trio, as explained, preceding.

The alternator also is equipped with a fan (mounted on the rotor shaft) which induces air flow through the alternator to remove the heat created by the rectifier and stator. A capacitor also is utilized to protect the rectifier system from high voltages and to suppress radio noise.

Diagnosis on Engine

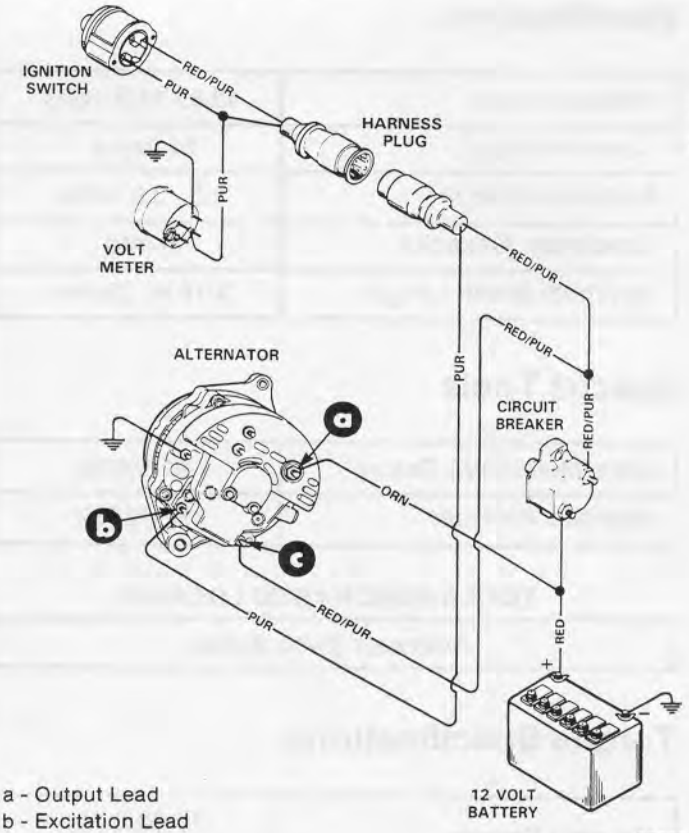
Before proceeding with the tests, perform the following checks to eliminate possible problem areas. Also observe "Precautions," immediately preceding, to prevent damage to alternator system.

1. If problem is an undercharged battery, check to ensure that undercharged condition has not been caused by excessive accessory current draw or by accessories which have accidentally been left on. Also, check that undercharged condition has not been caused by running engine at too low a speed for extended periods of time.
2. Check physical condition and state of charge of battery. Battery must be at least 75% (1.230 specific gravity) of fully charged to obtain valid results in the following tests. If not, charge battery before testing system.
3. Inspect entire alternator system wiring for defects. Check all connections for tightness and cleanliness, particularly battery cable clamps and battery terminals.
4. Check alternator drive belt and replace if necessary. Also, check tension and adjust if necessary, as outlined under "Drive Belt Replacement and Adjustment."

System Components

The alternator system, used on engines with Prestolite Alternators, consists of the alternator, battery, the ignition switch and the wiring which connects these components.

Typical Charging Circuit



a - Output Lead
b - Excitation Lead
c - Sensing Lead

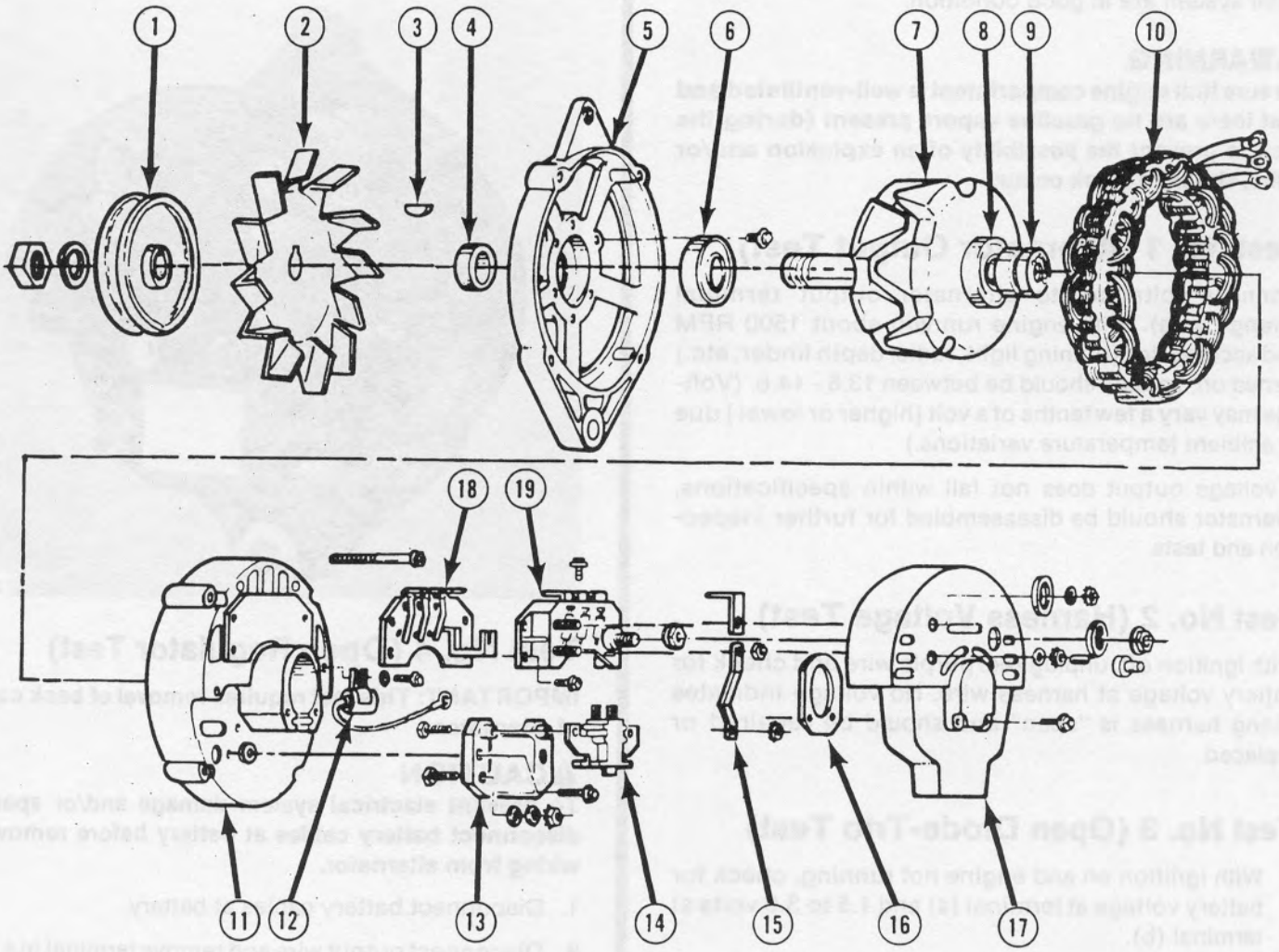
50623

Precautions

The following precautions must be observed when working on the alternator system. Failure to observe these precautions may result in serious damage to the alternator or alternator system.

1. Do not attempt to polarize the alternator.
2. Do not short across or ground any of the terminals on the alternator, except as specifically instructed.
3. Never disconnect the alternator output lead or battery cables when the alternator is being driven by the engine.
4. Never disconnect regulator lead from alternator regulator terminal when the alternator is being driven by the engine.
5. Always remove negative (-) battery cable from battery before working on alternator system.
6. When installing battery, be sure to connect the negative (-) (grounded) battery cable to negative (-) battery terminal and the positive (+) battery cable to positive (+) battery terminal.
7. If a charger or booster battery is to be used. Be sure to connect it in parallel with existing battery (positive to positive; negative to negative).

Prestolite Alternator



1 - Pulley
2 - Fan
3 - Woodruff Key
4 - Fan Spacer
5 - Front Housing
6 - Front Bearing
7 - Rotor
8 - Rear Bearing
9 - Slip Rings
10 - Stator
11 - Rear Housing
12 - Capacitor
13 - Voltage Regulator
14 - Brush Assembly
15 - Strap
16 - Felt Gasket
17 - Cover
18 - Rectifier Bridge
19 - Diode Trio

Alternator/Regulator Tests

Perform the following tests, using a 0-20 volt DC voltmeter, to check that all of the circuits between the alternator and the other components within the alternator system are in good condition.

⚠WARNING

Be sure that engine compartment is well-ventilated and that there are no gasoline vapors present (during the test) to prevent the possibility of an explosion and/or a fire, should a spark occur.

Test No. 1 (Alternator Output Test)

Connect voltmeter to alternator output terminal (orange wire). With engine running about 1500 RPM and accessories (running light, radio, depth finder, etc.) turned on, voltage should be between 13.8 - 14.8. (Voltage may vary a few tenths of a volt [higher or lower] due to ambient temperature variations.)

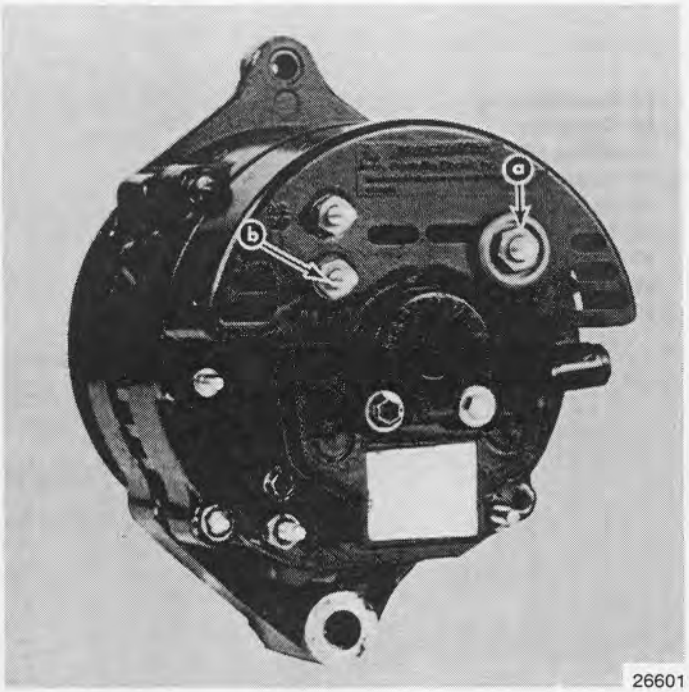
If voltage output does not fall within specifications, alternator should be disassembled for further inspection and tests.

Test No. 2 (Harness Voltage Test)

With ignition off, unplug red/purple wire and check for battery voltage at harness wire. No voltage indicates wiring harness is "open" and should be repaired or replaced.

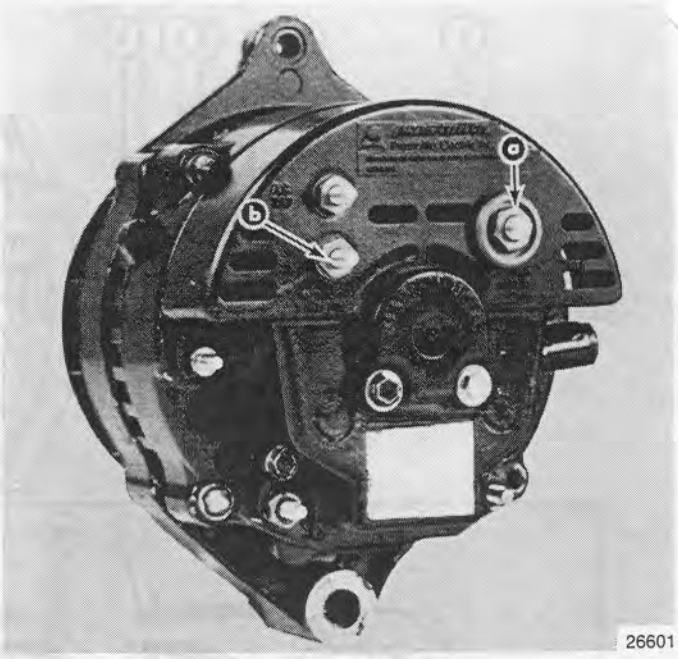
Test No. 3 (Open Diode-Trio Test)

1. With ignition on and engine not running, check for battery voltage at terminal (a) and 1.5 to 3.0 volts at terminal (b).



26601

2. Connect a jumper wire between terminal (a) and (b). Start engine and run at idle. If charging voltage (13.8 - 14.8 volts) is present at terminal (a), the diode-trio is probably defective and alternator should be removed for repair.



26601

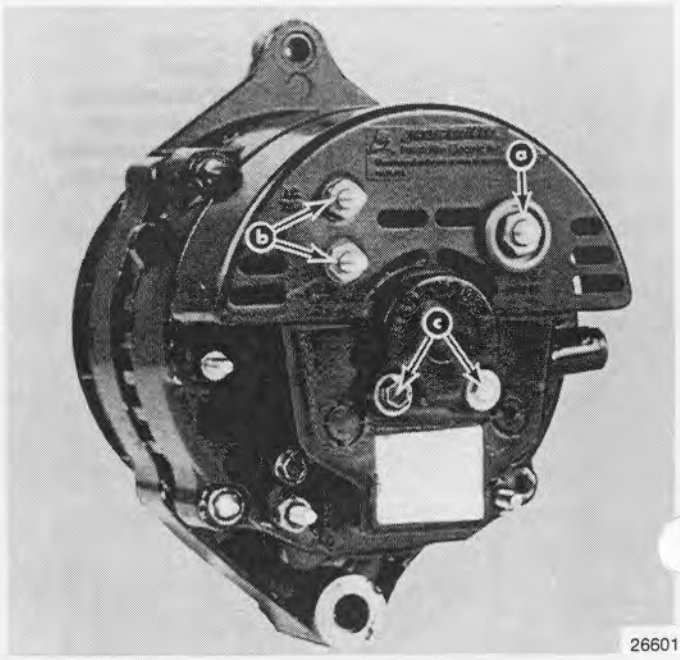
Test No. 4 (Open Regulator Test)

IMPORTANT: This test requires removal of back cover of alternator.

⚠CAUTION

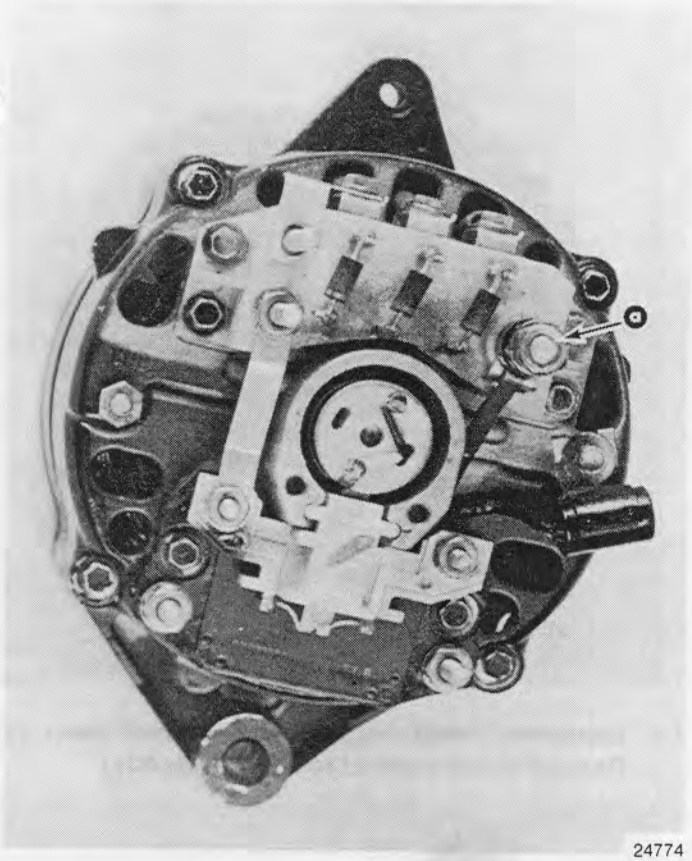
To prevent electrical system damage and/or sparks, disconnect battery cables at battery before removing wiring from alternator.

1. Disconnect battery cables at battery.
2. Disconnect output wire and remove terminal nut (a). Remove nuts (b) and screws (c). Remove cover.



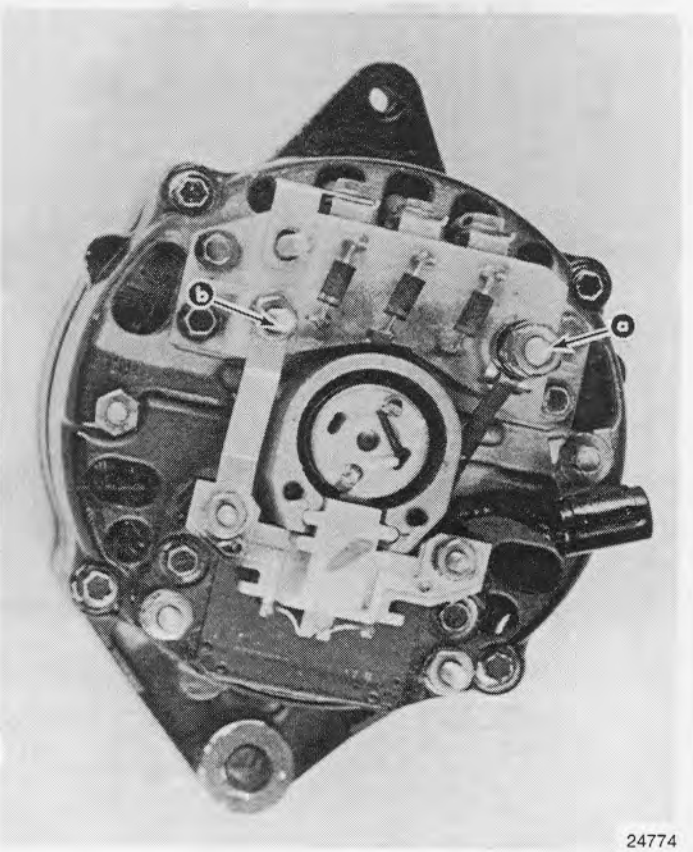
26601

3. Reconnect output wire on terminal (a). Reconnect battery cables.



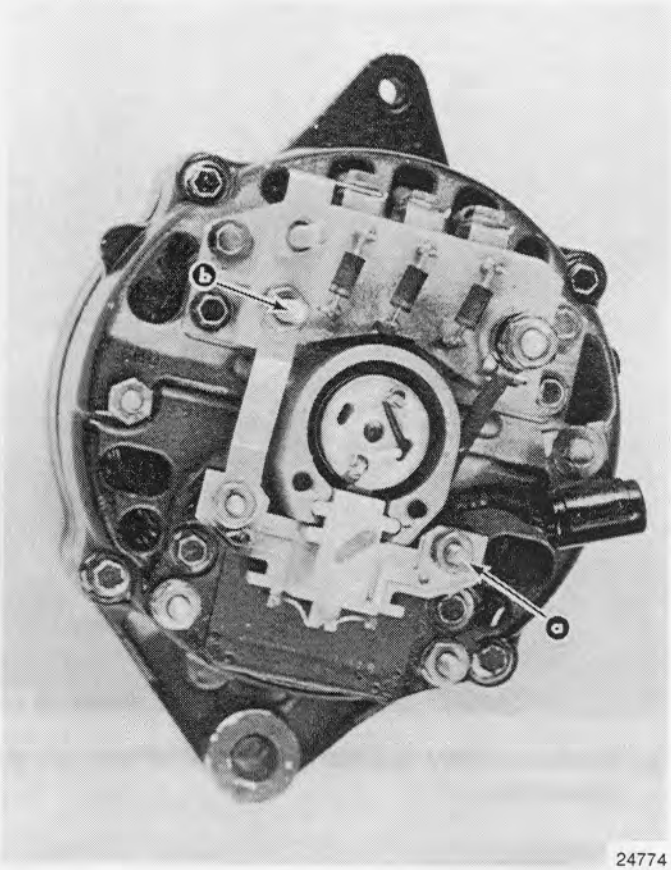
24774

4. With ignition switch on and engine not running, check for battery voltage at terminal (a) and terminal (b).



24774

5. Connect a jumper wire between field terminal (a) and ground. If 1.5 to 3.0 volts are present at terminal (b), regulator is defective. If voltage is not present at terminal (b), there is an open field circuit (brushes, slip rings, etc.). Remove alternator for repair.



24774

Repair

⚠WARNING

Be sure that engine compartment is well-ventilated and that there are no gasoline vapors present to prevent the possibility of an explosion and/or a fire, should a spark occur.

Removal

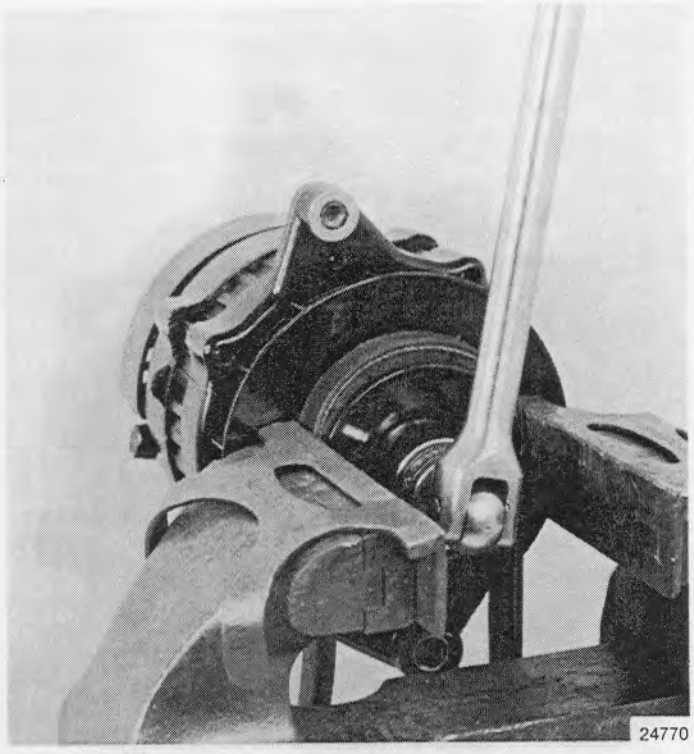
⚠CAUTION

Remove all battery cables from battery (before conducting the following check) to prevent accidentally shorting out electrical system.

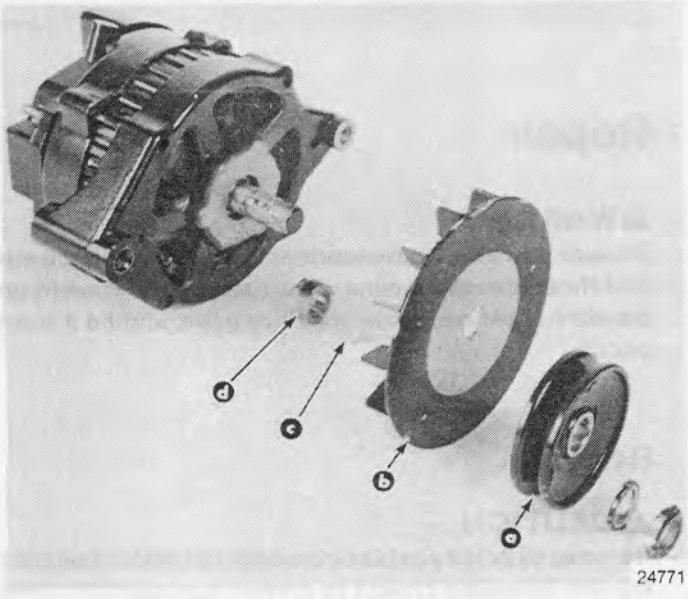
1. Disconnect battery cables from battery.
2. Disconnect wiring harness from alternator.
3. Remove V-belt.
4. Remove alternator.

Disassembly

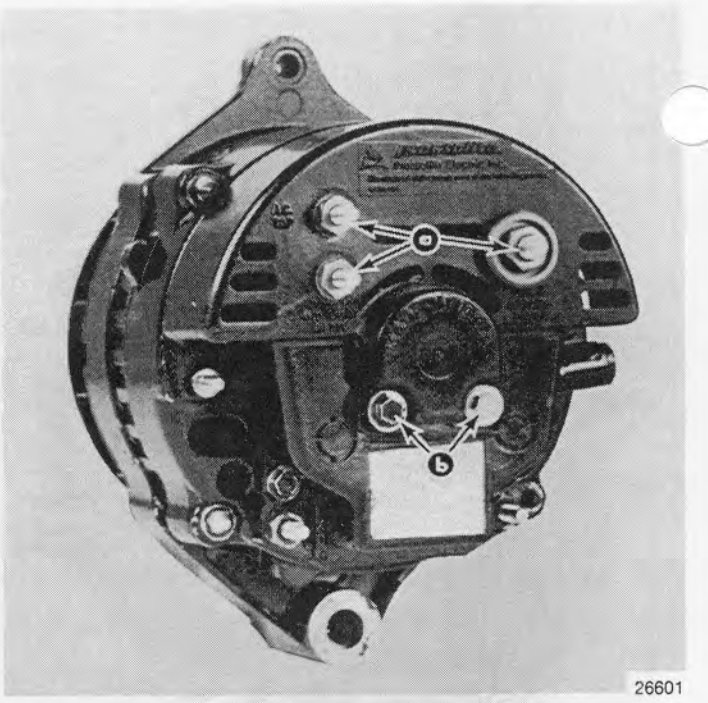
1. Using an oversized V-belt to protect the pulley, clamp alternator in vise, as shown. Remove pulley nut.



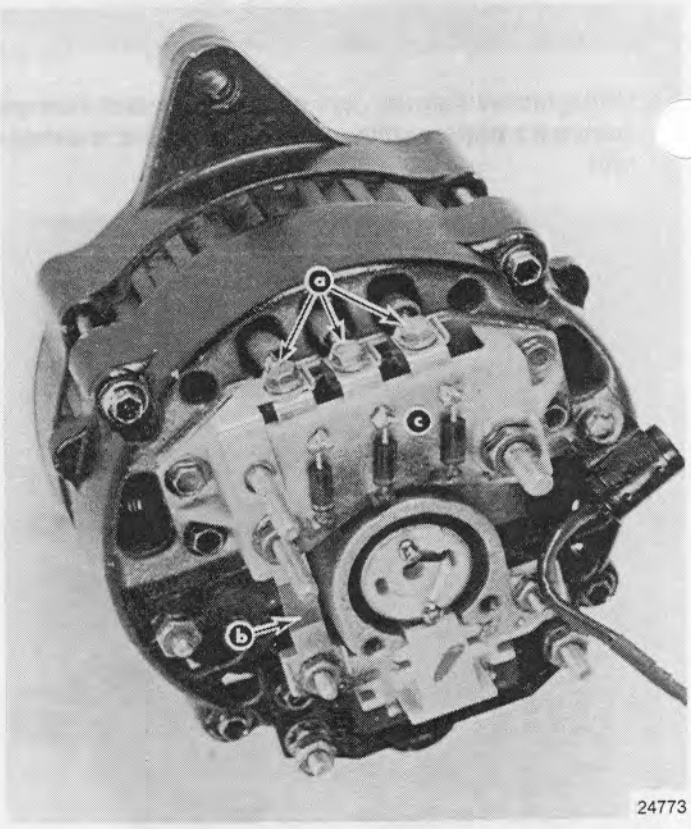
2. Remove pulley (a), fan (b), woodruff key (c) and spacer (d).



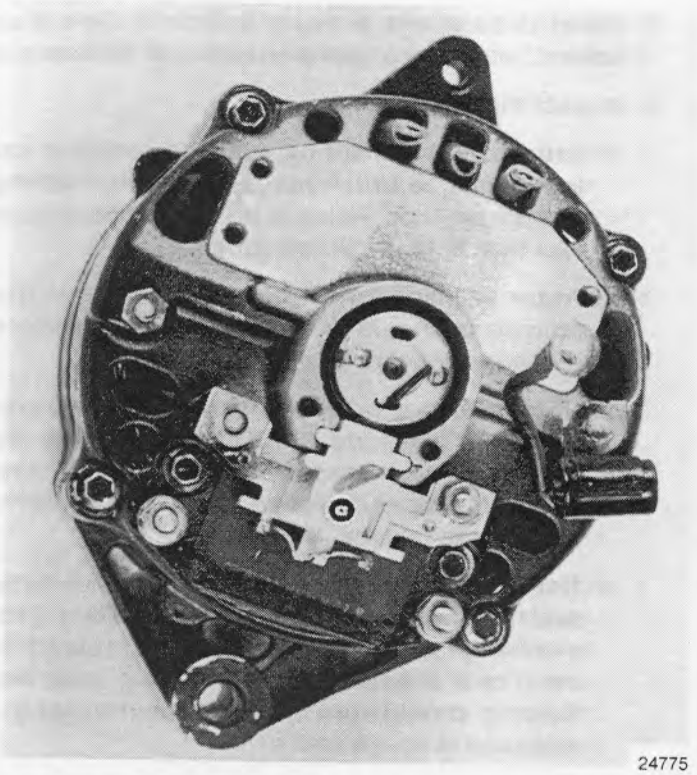
3. Remove nuts (a) and screws (b) to remove rear cover.



4. Disconnect stator wires (a). Remove strap (b). Remove diode-trio and rectifier bridge (c).



5. Remove brush holder (a).



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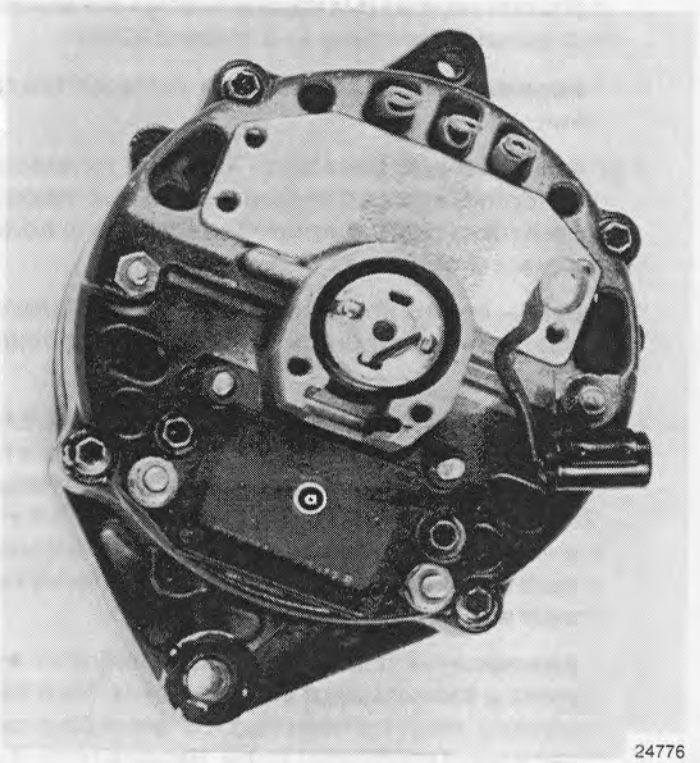
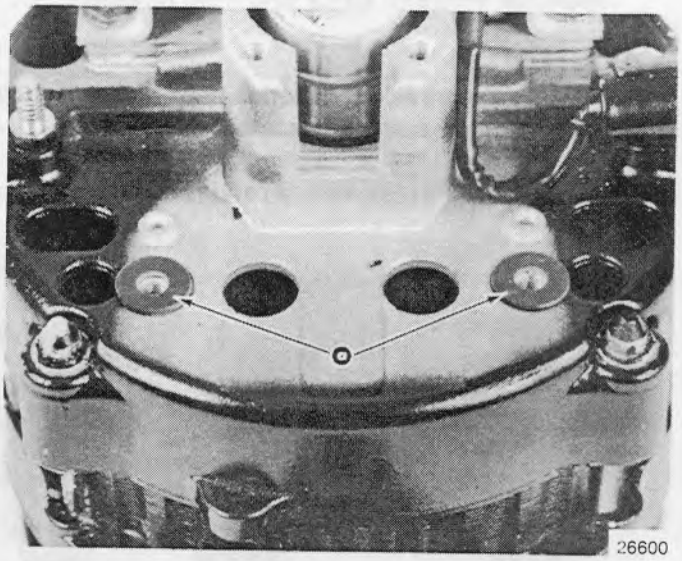
6. Remove regulator (a).



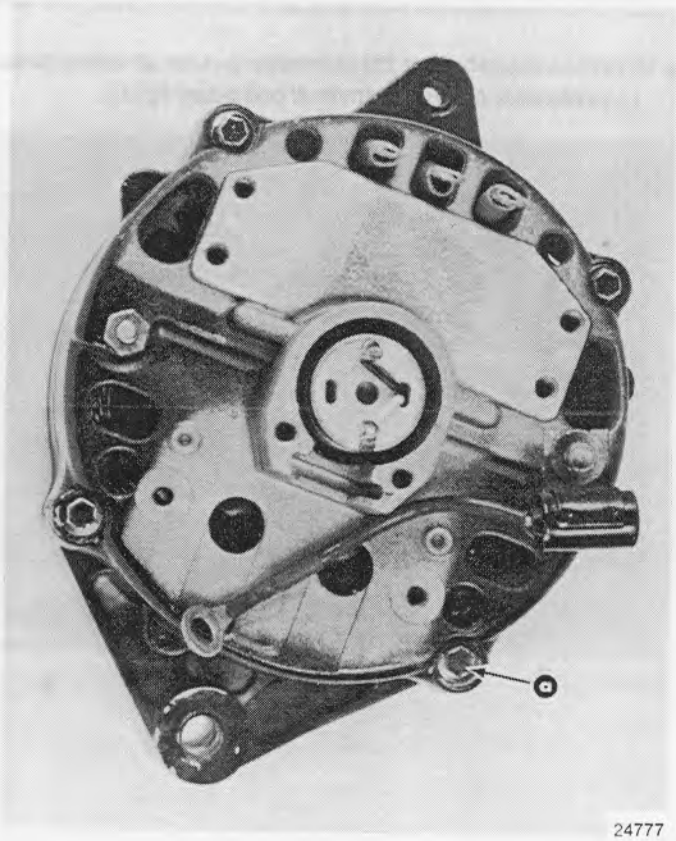
24776

IMPORTANT: Do not lose fiber washers (a).



26600

7. Mark front housing, stator, and rear housing for reassembly. Remove four (4) screws (a).

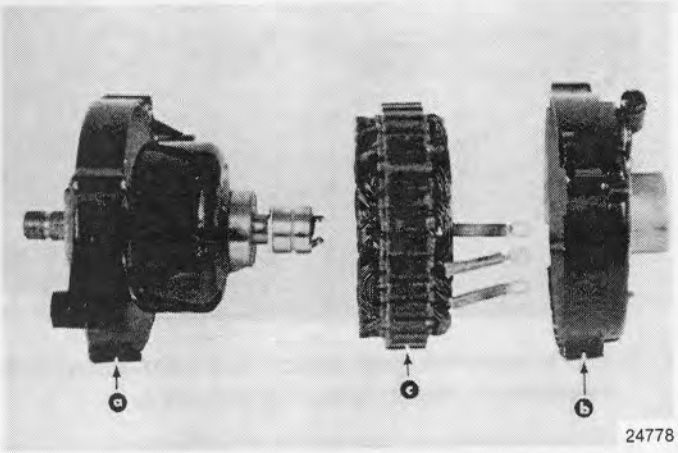


24777

8. Carefully insert two screwdriver blades in opposite openings between stator and front housing.

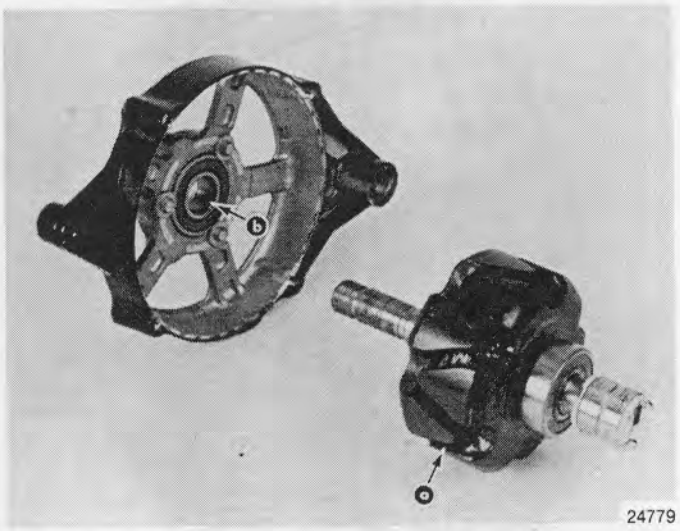
⚠CAUTION
Do not insert screwdriver blades deeper than 1/16 in. (1.5mm) to avoid damaging stator windings.

Pry front and rear housings, (a) and (b), from stator (c).



24778

9. While supporting front housing, use an arbor press to remove rotor (a) from front bearing (b).



24779

Inspection and Cleaning

1. Clean all parts with a clean, soft cloth. Do not use solvent, or electrical components may be damaged.
2. Inspect the following:
   a. **Brush set** — inspect for cracked porcelain casing, damaged brush leads, poor brush springs or worn brushes. Replace brush set if brushes are less than 3/16 in. (5mm) long.
   b. **Rotor** — inspect for stripped threads, scuffed pole piece fingers or damaged bearing surfaces (because of bearing turning on shaft).
   c. **Rotor slip rings** — clean slip rings with 400 grain (or finer) polishing cloth. Blow off dust with compressed air. Inspect slip rings for grooves, pits, flat spots, or out-of-round (.002 in. [0.05mm] maximum); replace, if defective.
   d. **Rotor shaft bearings** — inspect for damaged seals, lack of lubrication, discoloration (from overheating) or excessive side or end play. Hold inner race of bearings while turning outer race. Bearing should turn freely without binding or evidence of rough spots.
   e. **Stator** — inspect for damaged insulation or wires; also inspect insulating enamel for heat discoloration, as this is usually a sign of a shorted or grounded winding or a shorted diode.
   f. **Regulator** — inspect leads for damaged insulation.
   g. **Front and rear housings** — inspect for cracks, distortion, stripped threads or wear in bearing bore (from bearing outer race spinning in bore); replace if defective.
   h. **Fan** — inspect for cracked or bent fins, broken welds or worn mounting hole (from fan spinning on shaft).
   i. **Pulley** — inspect pulley mounting bore end for wear. Inspect drive surface of pulley sheaves for trueness, excessive wear, or corrosion. Repair damaged surfaces, if possible, with a fine file and a wire brush or replace pulley. Drive surfaces must be perfectly true and smooth, or drive belt wear will be greatly accelerated.
   j. **Alternator** — if alternator has output at low speeds, but no output at high speeds, rotor field winding may be shorting or grounding out, because of centrifugal force. Replace rotor, if all other electrical components test good.

Front Bearing

Removal

1. Remove retaining screws.
2. Use an arbor press to remove bearing from housing.

Installation

1. Using an arbor press, press on outer race of new bearing until fully seated in housing.
2. Install retaining screws. Tighten to 25-35 lb. in. (3 N·m).

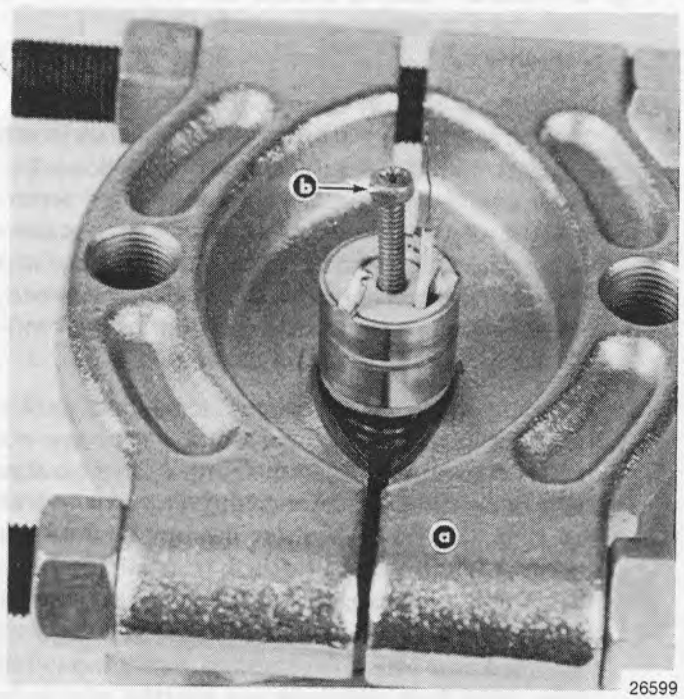
Slip Rings/Rear Bearing

Removal

1. Unsolder wires and carefully unwind them from slip ring terminals.

IMPORTANT: Do not damage rotor wires when removing slip rings or bearing.

2. Install a universal puller plate (a) between bearing and slip rings. Insert a 10 x 1 in. cap screw (b) into opening of slip ring assembly.

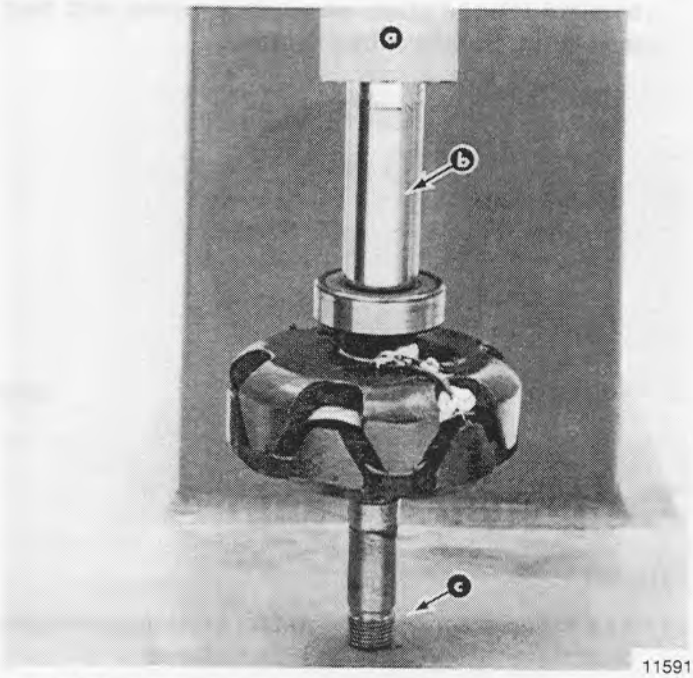


26599

3. Using an arbor press, push against cap screw to remove slip rings.
4. Install a universal puller plate under bearing.
5. Using an arbor press, remove bearing.

Installation

1. Press new rear bearing all-the-way onto rotor shaft (until inner race contacts shoulder) with an arbor press and a bearing driver that contacts inner bearing race only, as shown. Use extreme care to prevent damage to field winding leads.



11591

a - Arbor Press
b - Bearing Driver (Must Contact Inner Bearing Race Only)
c - Support Pulley End of Shaft on Arbor Press Base (DO NOT Support Rotor on Pole Pieces)

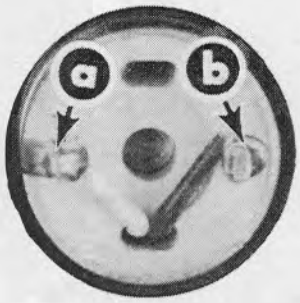
IMPORTANT: Be sure to support rotor on end of shaft and not on pole pieces, as pole pieces are only press-fit onto shaft.

2. Insert wires thru hole in slip rings as shown.

26598

IMPORTANT: Press on the center of slip rings only. Do not bend terminals or pinch wires.

3. Using an arbor press, install slip rings. Press on center of slip rings until they contact shoulder of rotor.
4. Carefully wrap white wire around outer slip ring terminal (a) and black wire around inner slip ring terminal (b). Solder wires in place.

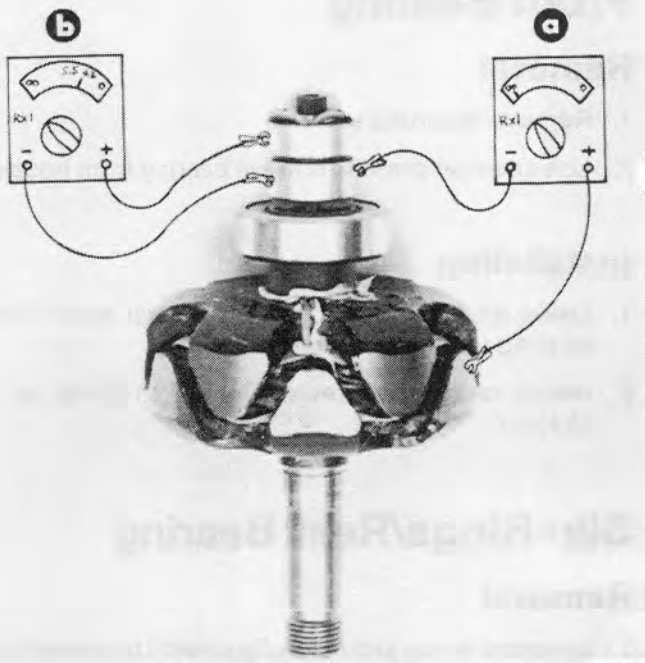


24777

Component Testing

Rotor

1. **TEST 1:** Test rotor field circuit for grounds, using an ohmmeter (set on Rx1 scale), as follows:
   a. Connect one lead of ohmmeter to either slip ring and the other lead to rotor shaft or pole pieces.
   b. Meter should indicate no continuity (meter should not move).
   c. If continuity does exist, rotor field circuit is grounded. Inspect slip ring terminals to be sure that they are not bent and touching rotor shaft. Also be sure that excess solder is not grounding terminals to rotor shaft. If cause for ground cannot be found, unsolder field winding leads from slip ring terminals and connect ohmmeter between one of the leads and rotor shaft or pole pieces. If continuity still exists, replace rotor assembly. If continuity is eliminated, replace slip rings.



11587

2. **TEST 2:** Test rotor field circuit for "opens," shorts or high resistance, using an ohmmeter (set on Rx1 scale), as follows:
   a. Connect one ohmmeter lead to each slip ring.
   b. Ohmmeter reading should be 4.1 to 4.7 ohms with rotor at room temperature [70°-80° F (21°-26° C)].
   c. If reading is high or infinite (no meter movement), high resistance or an "open" exists in the field circuit. Check for poor connections between field winding leads and slip ring terminals. If cause for "open" or high resistance cannot be found, connect ohmmeter directly to slip ring terminals. If correct reading is now obtained, replace slip rings. If reading is still high or infinite, replace complete rotor assembly.
   d. If reading is low, a short exists in the field circuit. Inspect slip rings to be sure that they are not bent and touching outer slip ring. Also be sure that excess solder is not shorting terminals to aft slip ring. If cause for short cannot be found, unsolder field winding leads from slip ring terminals and connect ohmmeter directly to leads. If correct reading is now obtained, slip rings are shorted and must be replaced. If reading is still low, rotor field windings are shorted, and complete rotor assembly must be replaced.

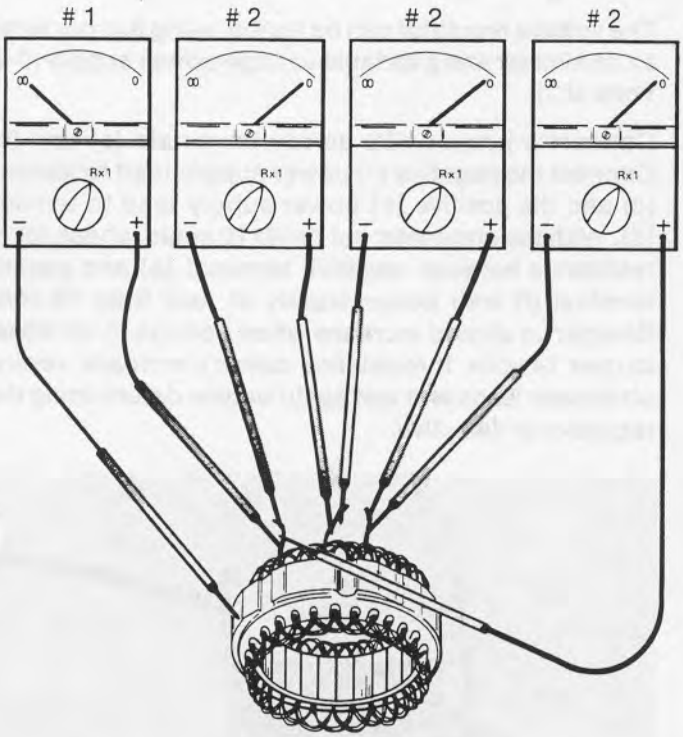
STATOR

IMPORTANT: Stator leads must be disconnected from rectifier diodes and diode trio for this test.

1. **TEST 1:** Test stator for "grounds," using an ohmmeter (set on Rx1 scale) as follows:

   a. Connect one lead of ohmmeter or test lamp to one of the stator leads and the other lead to stator frame. Be sure that lead makes good contact with frame.

      Meter should indicate no continuity (meter should not move). If continuity does exist, stator is grounded and must be replaced.



2. **TEST 2:** Test for "opens" in stator, using an ohmmeter (set on Rx1 scale) as follows:

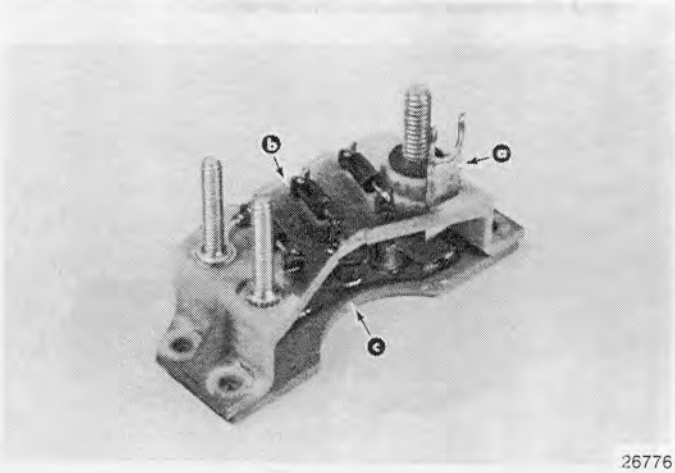
   a. Connect ohmmeter or test lamp between each pair of stator windings (3 different ways). Either of the 2 leads (coming from each stator windings) may be used.

      Continuity should be present in all 3 cases (meter should move); if it does not, one or more of the windings are open and stator must be replaced.

3. A short in the stator is difficult to detect without special equipment, because of the low windings resistance. If all other electrical components test out good, and alternator fails to produce rated output, stator probably is shorted and should be replaced. Also, examine stator for heat discolorations, as this usually is a sign of a short.

Rectifier Bridge/Diode Trio Assembly

Straighten strap (a) as shown. Pull diode trio (b) and rectifier bridge (c) apart.



26776

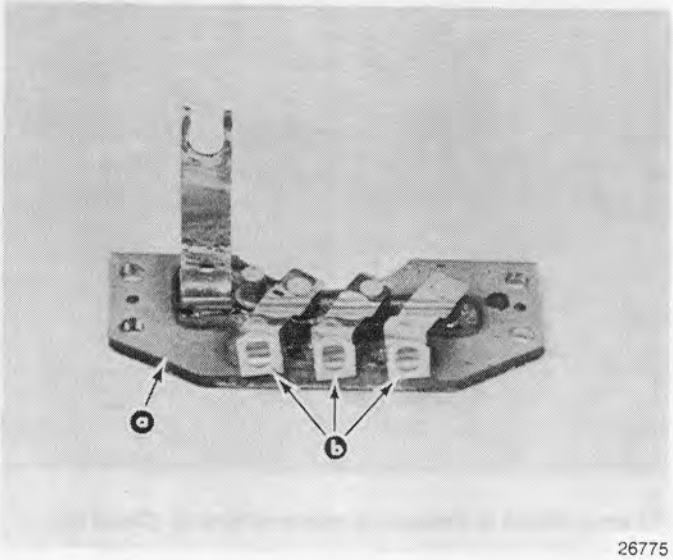
⚠CAUTION

Do not use a test instrument with more than a 12-volt source (in the following test), as rectifier diodes may be damaged.

IMPORTANT: Rectifier diodes must be disconnected from stator for this test.

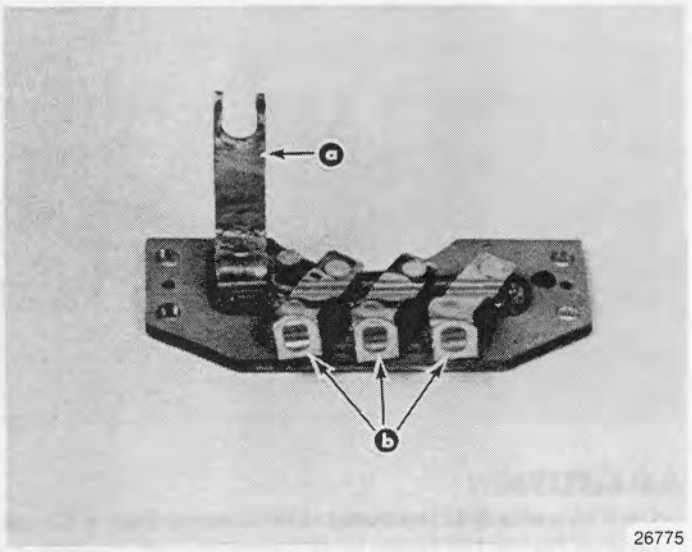
RECTIFIER BRIDGE

1. Using an ohmmeter (set on Rx1 scale), check for continuity between point (a) and each diode (b). Switch ohmmeter leads and recheck. Continuity should be observed in one direction (polarity) only, and all diodes should check alike.



26775

2. Using an ohmmeter (set on Rx1 scale), check for continuity between strap (a) and each diode (b). Switch ohmmeter leads and recheck. Continuity should be observed in one direction (polarity) only, and all diodes should check alike.

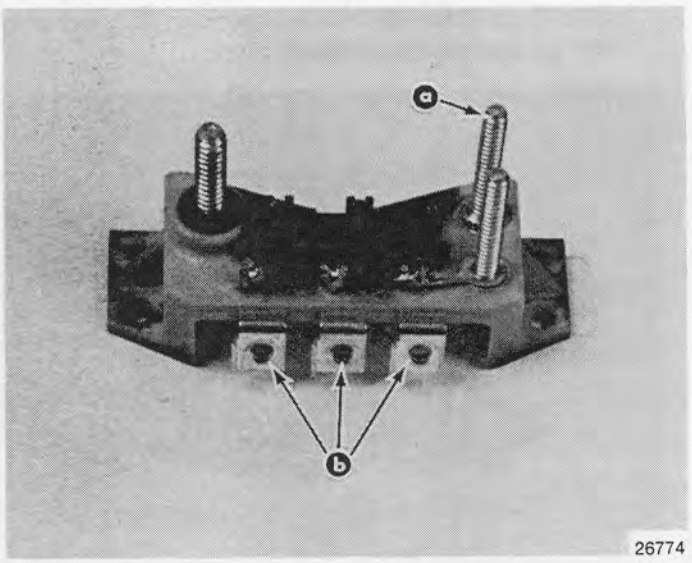


26775

If any diode is defective, replace entire rectifier bridge.

DIODE TRIO

1. Using an ohmmeter (set on Rx1 scale), check for continuity between stud (a) and each terminal (b). Switch ohmmeter leads and recheck. Continuity should be observed in one direction (polarity) only, and all diodes should check alike.



26774

If any diode is defective, replace entire diode trio.

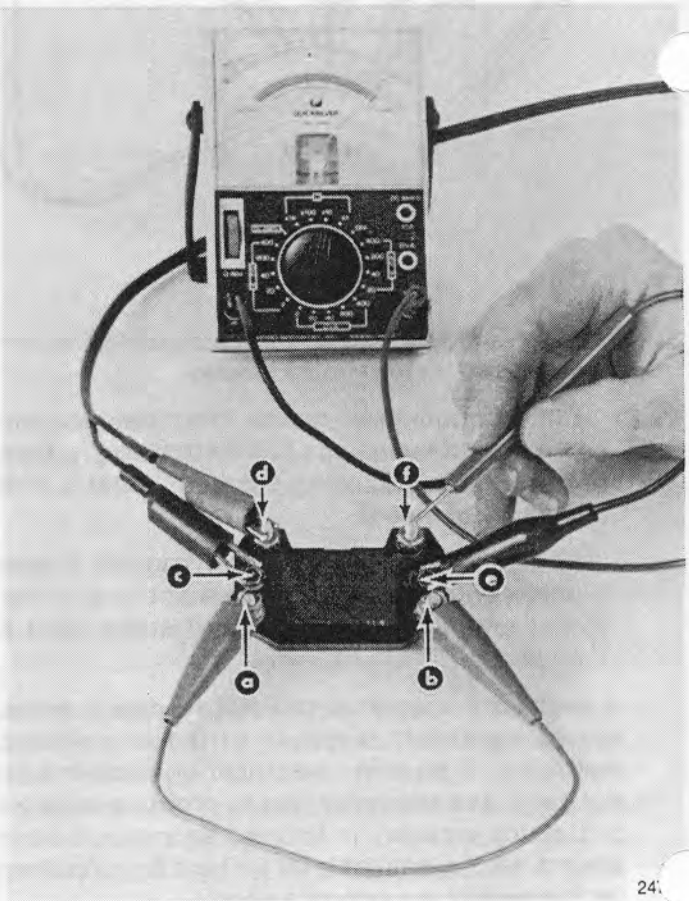
Condenser

1. Using Magneto Analyzer 91-76032 and accompanying instructions, perform the following condenser tests:
   a. Condenser Capacity Test (must be .5 mfd).
   b. Condenser Short or Leakage Test.
   c. Condenser Series Resistance Test.
2. Replace condenser, if test results are not within specifications.

Voltage Regulator Test

The voltage regulator can be tested using jumper wires, an ohmmeter and a variable voltage power supply (0-20 Volts DC).

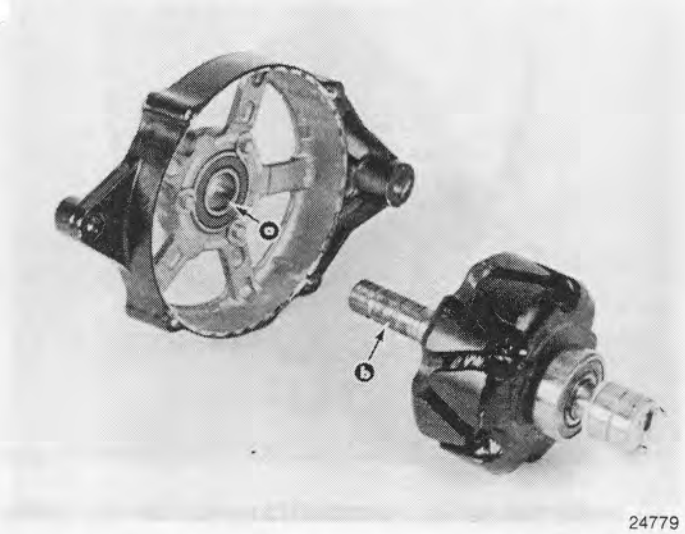
Connect a jumper wire across terminals (a) and (b). Connect the negative (-) power supply lead to terminal (c) and the positive (+) power supply lead to terminal (d). With the ohmmeter set on Rx10 scale, check for no resistance between negative terminal (e) and positive terminal (f) with power supply at less than 12 volts. Resistance should increase when voltage is increased to over 14 volts. If resistance doesn't increase, reverse ohmmeter leads and test again before determining that regulator is defective.



24

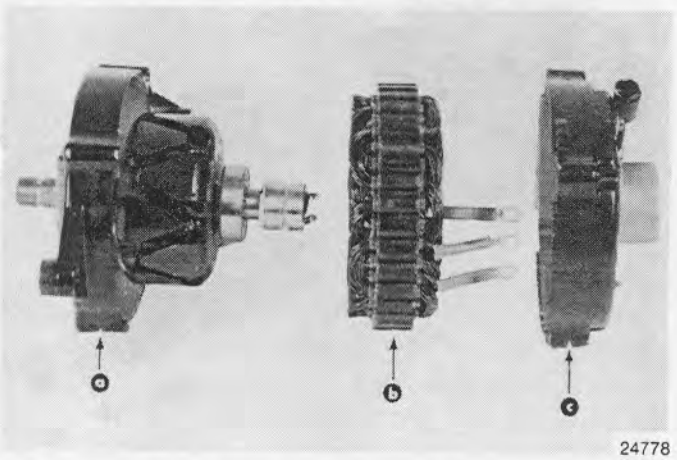
Assembly

1. Using an arbor press, install front housing with bearing (a) on rotor (b). Press only on center race of bearing until it contacts shoulder of rotor.



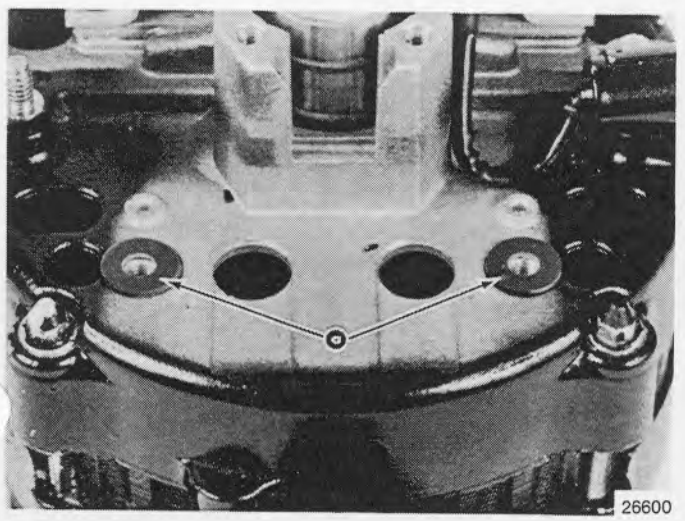
24779

2. Aligning marks made during disassembly, assemble front housing (a), stator (b) and rear housing (c). Tighten screws to 50-60 lb. in. (6 N·m).



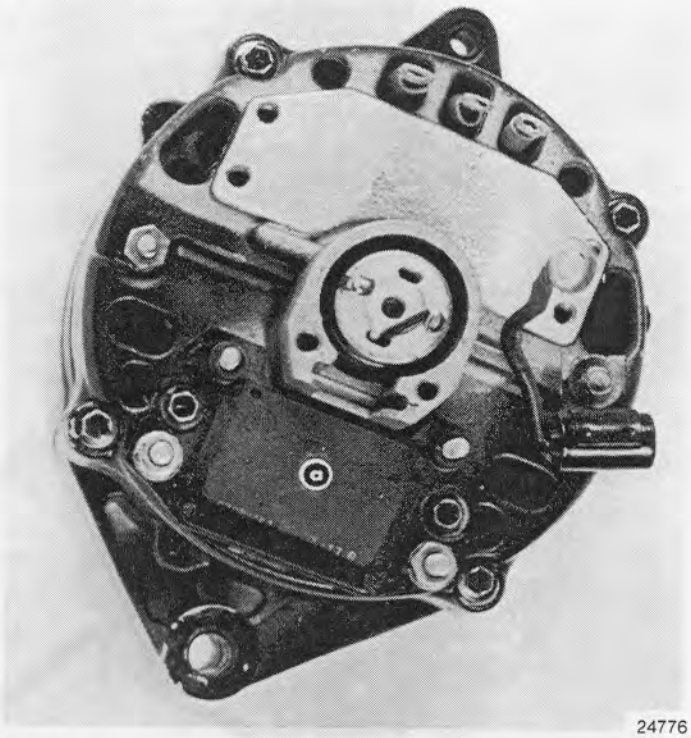
24778

3. Set fiber insulating washers (a) in place on rear housing.



26600

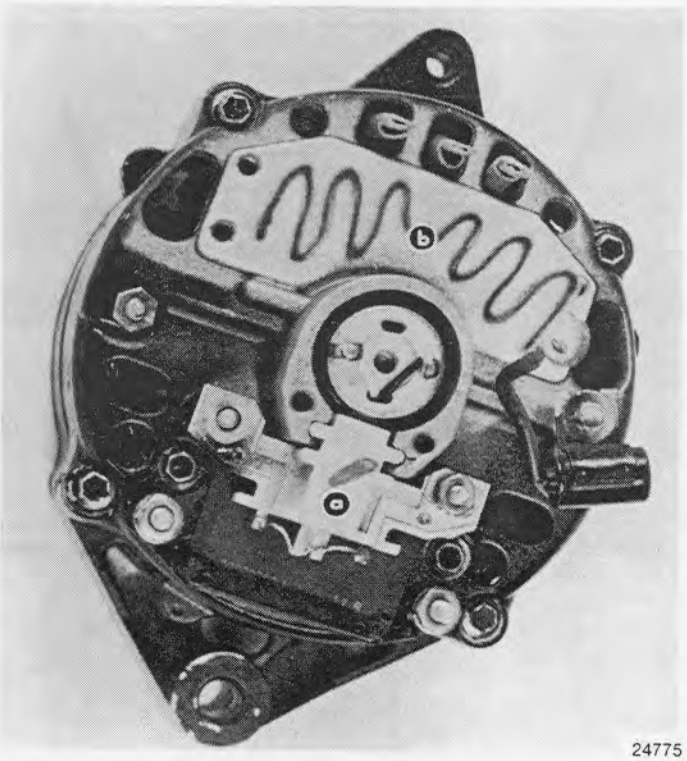
4. Install voltage regulator (a). Tighten screws securely.



24776

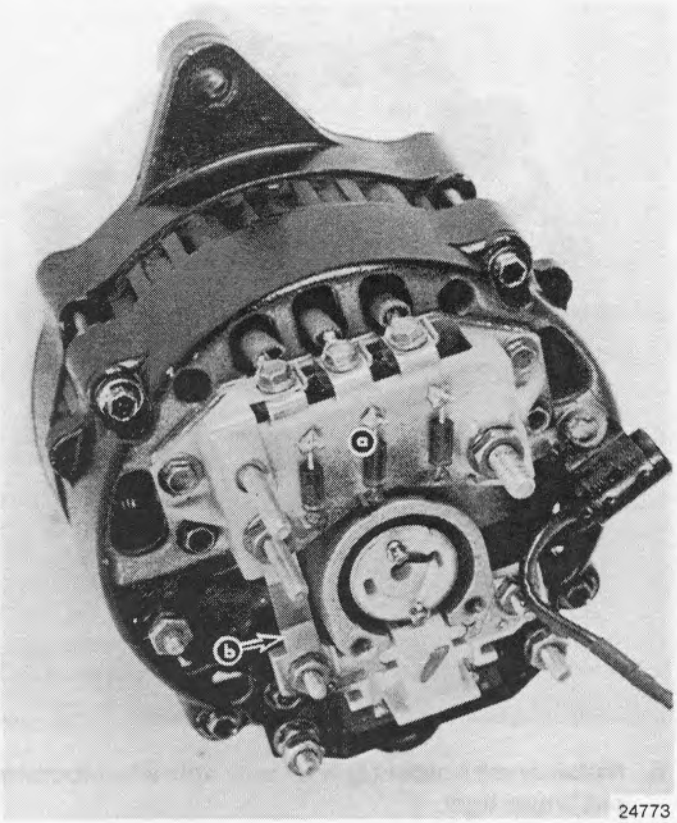
5. Install brush holder (a) with only right side mounting nut finger tight.

   Apply a thin coating of heat sink compound to housing (b).



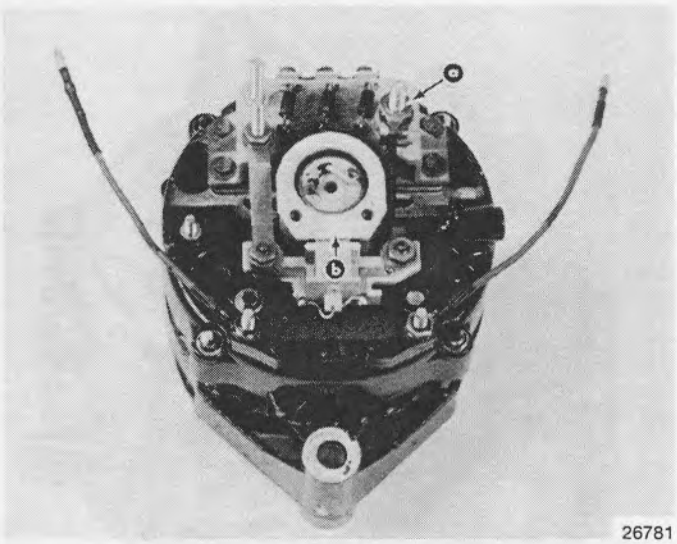
24775

6. Install diode trio/rectifier bridge assembly (a) and strap (b). Tighten mounting screws, stator screws and brush holder nuts securely.



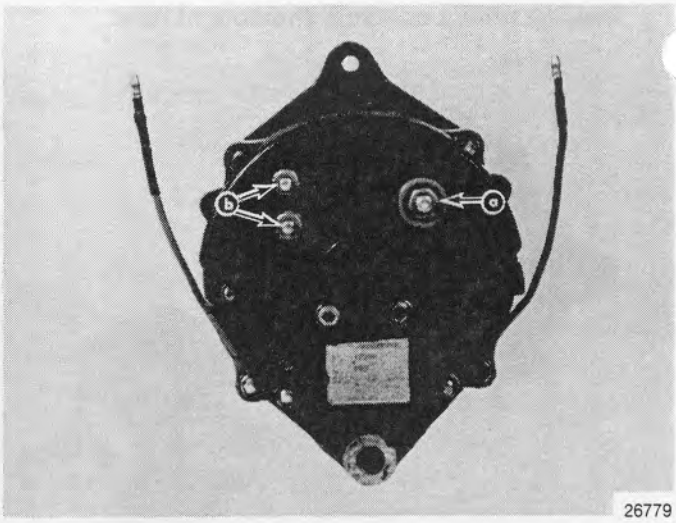
24773

7. Place condenser lead (a) on output terminal and felt gasket (b) on rear housing.



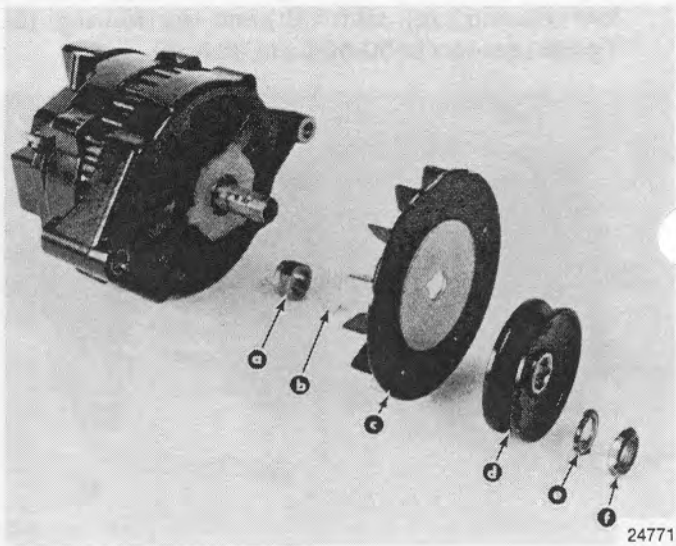
26781

8. Install cover, tighten screws securely.
9. Install insulator and nut on output terminal (a). Install nuts (b). Tighten all nuts securely.



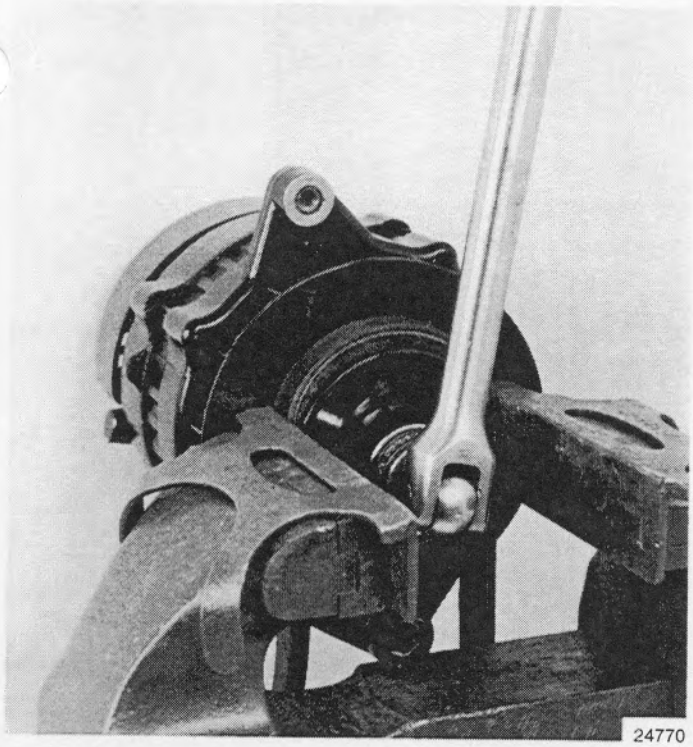
26779

10. Install spacer (a), woodruff key (b), fan (c), pulley (d), lock washer (e) and nut (f).



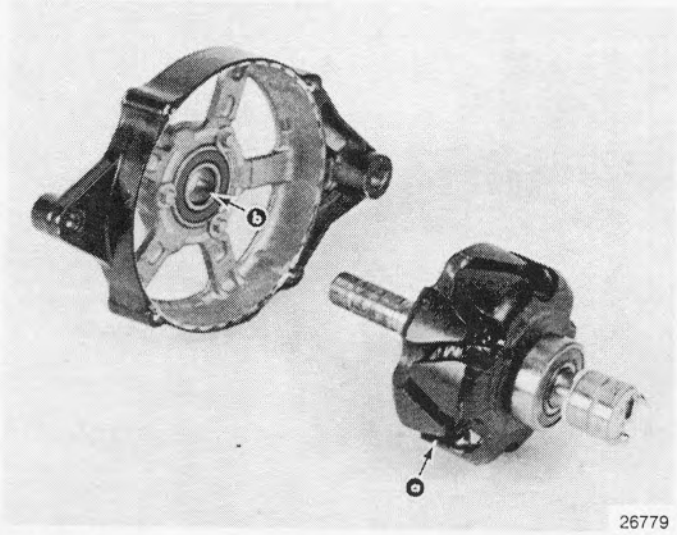
24771

11. Using an oversized belt to protect the pulley, clamp alternator in vise as shown. Tighten pulley nut to 35-50 lb. ft. (48-68 N·m).


24770

Installation

1. Install alternator on engine.
2. Install alternator belt. Tighten to specifications.
3. Tighten mounting bolts to specifications.
4. Connect alternator wires as shown.

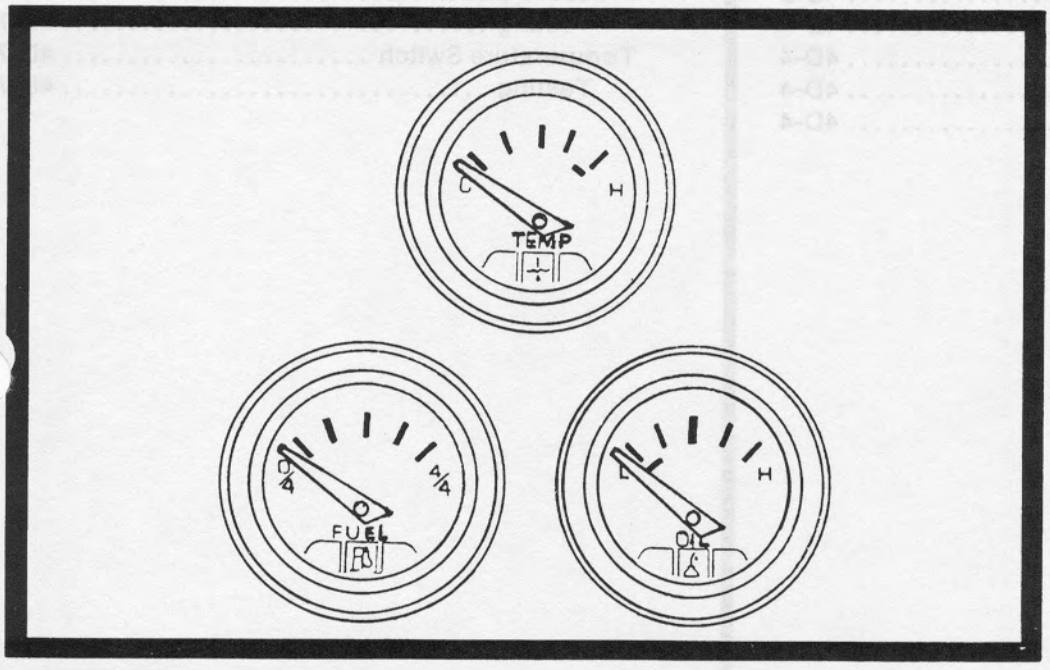


26779

a - Orange
b - Purple
c - Red/Purple

5. Position alternator drive belt on pulleys and adjust tension as explained under "Drive Belt Tension Adjustment."
6. Connect battery cables to battery.

ELECTRICAL SYSTEMS



4

D

INSTRUMENTATION

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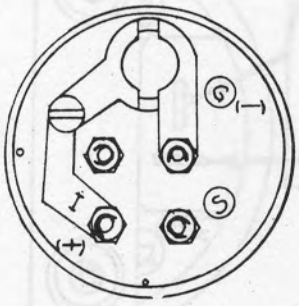
Gauges

Oil, Fuel and Temperature

IMPORTANT: If testing proves gauge to be defective, it must be replaced as there is no repair available.

TESTING

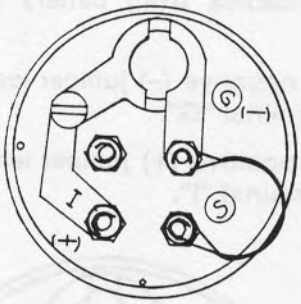
1. Turn ignition switch "Off".
2. Remove wire from terminal "S".



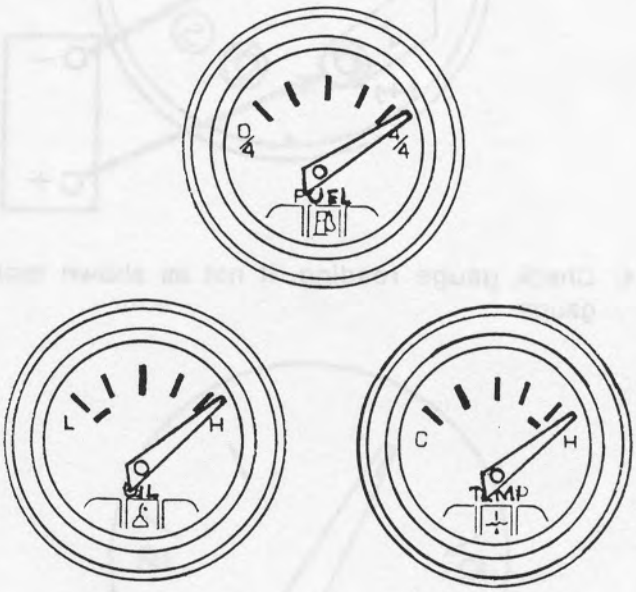
3. Turn ignition switch to "Run". Gauges must be at "A" position.

POSITION -A-

4. Turn ignition switch "Off".
5. Connect jumper wire from terminal "G" to terminal "S".



6. Turn ignition switch to "Run".
7. Indicator needle must read at "B". If not, replace gauge.

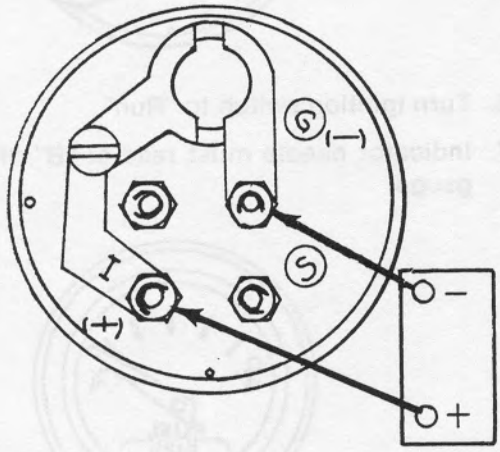


POSITION -B-

Battery Gauge

TESTING

1. Remove cables from battery and fully charge battery.
2. Connect negative (-) jumper lead from battery to gauge terminal "G".
3. Connect positive (+) jumper lead from battery to gauge terminal "I".

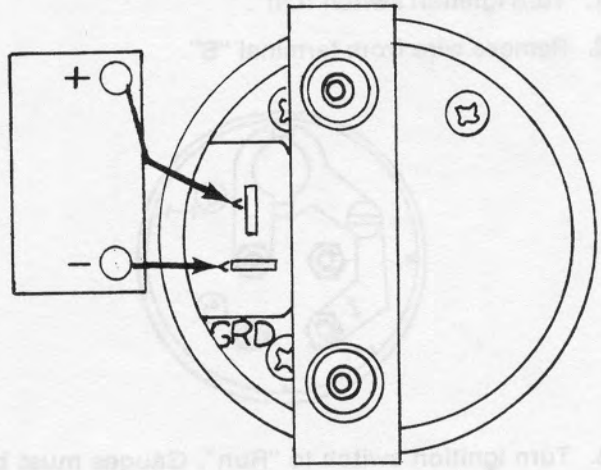


4. Check gauge reading, if not as shown replace gauge.

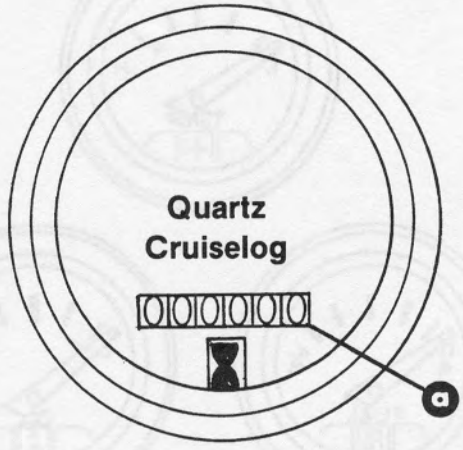
Cruiselog Meter

TESTING

1. Connect jumper wire from negative (-) battery terminal to negative (-) gauge terminal.
2. Connect jumper wire from positive (+) batttery terminal to positive (+) gauge terminal.



3. Observe gauge run indicator, if it is turning gauge is operable, if not replace gauge.



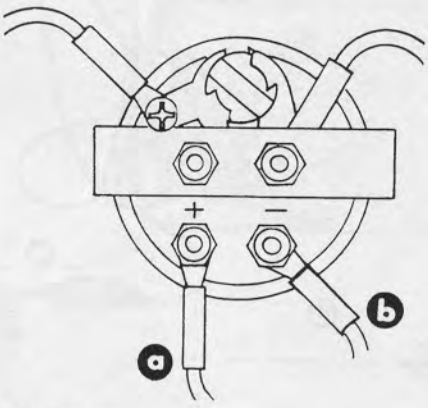
a - Run Indicator

Ammeter Gauge

TESTING

1. Disconnect battery cables at battery.
2. Connect positive (+) lead of service ammeter to orange wire, and negative (-) lead to red/purple.

IMPORTANT: DO NOT allow wires to come in contact with metal or other wires.



a - Positive (Orange)
b - Negative (Red/Purple)

4. Connect battery cables to battery. Ground engine high tension coil wire to engine block. Crank engine over approximately 10 seconds (to remove battery surface charge), then reconnect coil wire, start engine and run at approximately 3000 RPM while observing service ammeter. Ammeter should be registering alternator output. If not, replace gauge.

Vacuum Gauge

TESTING

1. Disconnect vacuum hose from engine. Connect service vacuum gauge to engine and record engine vacuum readings at idle, 1000, 2000 and 3000 RPM. Reconnect vacuum hose and compare vacuum gauge readings (at specified RPM) with service gauge readings. Readings should be within 3 inches of vacuum of each other.

IMPORTANT: Make sure that vacuum hose between gauge and engine is not leaking and that all connections are tight.

Speedometer

TESTING

IMPORTANT: When testing speedometer gauge for accuracy, air pressure that is used for test must be regulated to specified PSI. DO NOT apply excessive air pressure to speedometer gauge.

1. Apply air pressure directly to speedometer gauge (specified in chart) and note gauge reading. Light tapping of pressure gauge is required during accuracy check.
2. If gauge readings are not within specifications, gauge is defective.

CALIBRATION CHART

Air Pressure Gauge PSI	Speedometer Gauge MPH
5.3	20 ± 1 (32km/hr ± 1.6)
27.8	45 ± 1 (72km/hr ± 1.6)

Tachometer

TESTING

1. Connect a service tachometer to engine and compare readings.
2. Replace if not within specifications.

TACHOMETER TYPE	ALLOWABLE RANGE
6000 RPM	± 150 RPM
8000 RPM	± 200 RPM

Senders

Oil Pressure

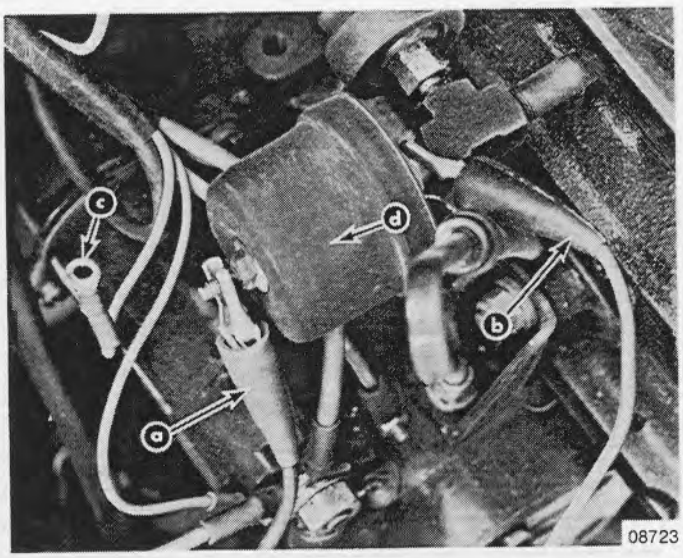
TESTING

⚠CAUTION

Use following test procedure for checking accuracy of oil pressure sender only. If oil pressure gauge indicates zero oil pressure, refer to "Troubleshooting" section.

1. Remove wire from sender terminal.
2. Connect ohmmeter between sender terminal and sender case. Check ohms reading without engine running (zero pressure), then check reading with engine running. Compare oil pressure and ohms readings as shown in following chart:

Oil Pressure (Lbs./Sq. In.)	Ohms Reading	
	Single	Dual
0	227-257	113.5-128.5
20	142-162.5	71-81.25
40	91.7-113.6	45.8-56.8
80	9-49	4.5-24.5



08723

a - Positive Lead
b - Negative Lead
c - Wire Removed
d - Oil Pressure Sender

Water Temperature

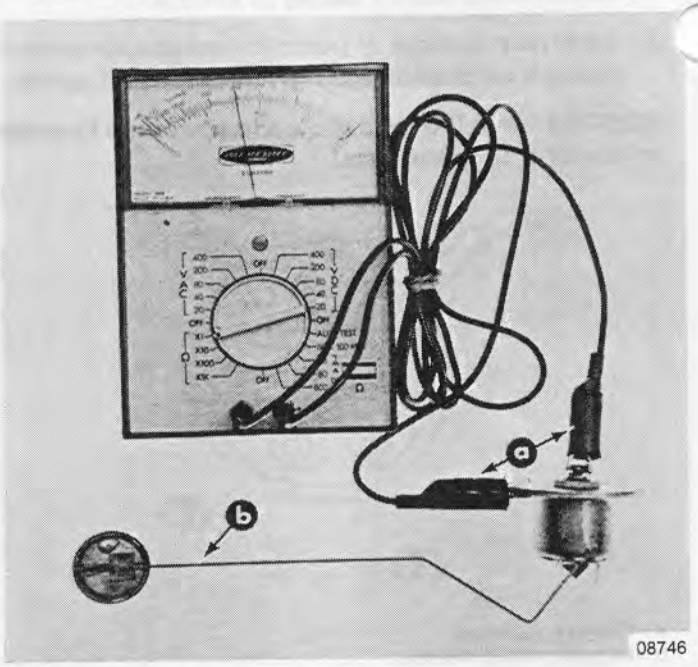
There is no test for sender, install new sender.

Fuel Tank Sender

FLANGE TYPE

Testing

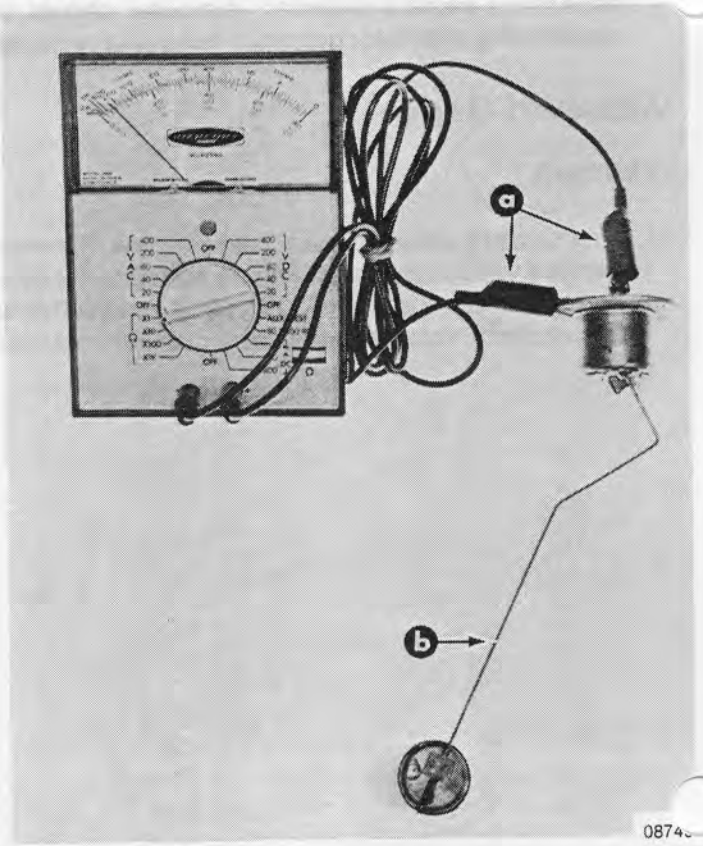
1. Disconnect wire from terminal on sending unit and ground wire from sending unit mounting screw.
2. Remove sending unit from fuel tank.
3. Connect ohms meter between sending unit terminal and sending unit housing.
4. With float arm in "full" position (arm horizontal), ohmmeter should read 30 ohms (± 5 ohms).



08746

a - Ohmmeter Leads
b - Float Arm Horizontal

5. With float arm in "empty" position (arm vertical) meter should read 240 ohms (± 5 ohms). Sender is defective if not within specifications.



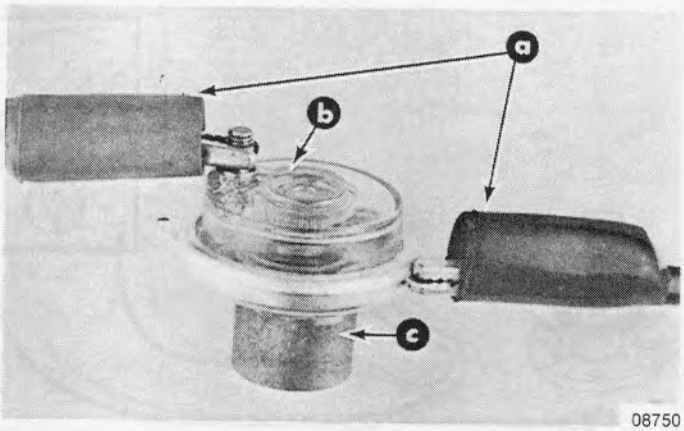
0874

a - Ohmmeter Leads
b - Vertical Float Arm

CAPSULE TYPE

Testing

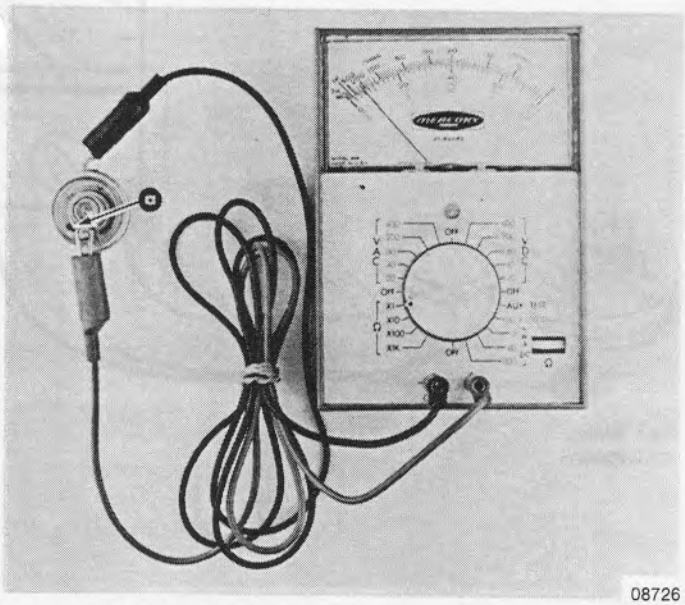
1. Disconnect wire from terminal on fuel tank capsule.
2. Remove 2 screws and remove capsule assembly.
3. Place a magnet under fuel capsule.
4. Connect ohmmeter between fuel capsule terminal and metal portion of capsule housing.



08750

a - Ohmmeter Leads
b - Capsule Assembly
c - Magnet

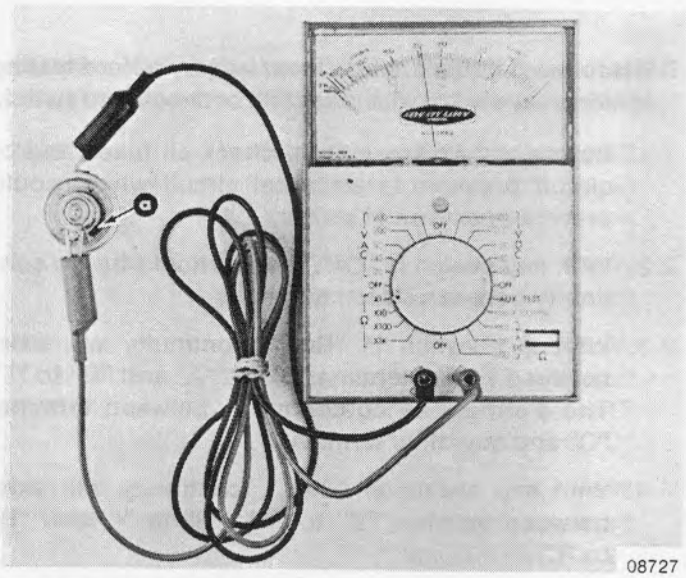
5. Turn magnet counterclockwise until fuel capsule indicator reads empty. Ohmmeter should read 240 ohms (± 5 ohms).



08726

a - Capsule Reading Empty

6. Turn magnet clockwise until fuel capsule indicator reads "Full". Ohmmeter should read 30 ohms (± 5 ohms). Fuel capsule is defective if not within specifications.



08727

a - Capsule Reading Full

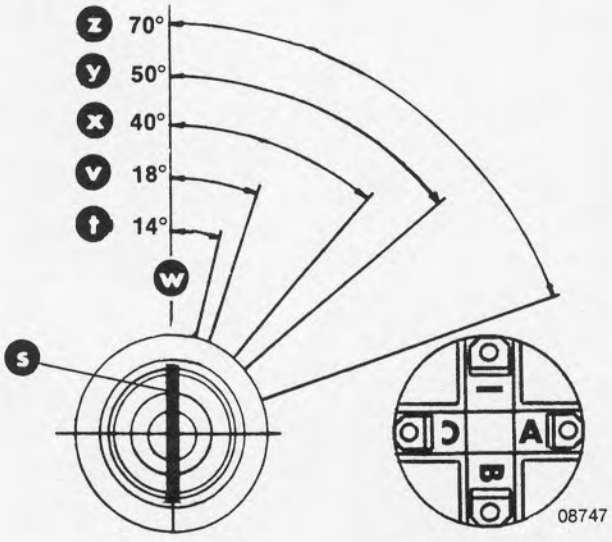
Switches

Ignition Key Switch

Testing

Disconnect battery cables from battery before testing ignition key switch with wires still connected to switch.

1. Before testing key switch, check all fuses and/or circuit breakers in electrical circuit which could prevent operation of starter.
2. With key switch in "Off", there should be no continuity between switch terminals.
3. With key switch in "Run", continuity will exist between switch terminal "B" to "A" and "B" to "I". There should be no continuity between terminal "C" and any other terminals.
4. With key switch in "Start", continuity will exist between terminal "B" to "A", "B" to "I" and "B" to "C".
5. Terminals are to make contact at angles shown and to stay in contact condition as switch is rotated toward "Start".
6. If ignition key switch tests bad, unsolder wire connections and remove switch. Test switch again, as in Steps 2-thru-5, preceding. If switch tests good, wiring in harness is bad. There should be no continuity between any harness wires with key switch removed.



KEY VIEW BACK VIEW

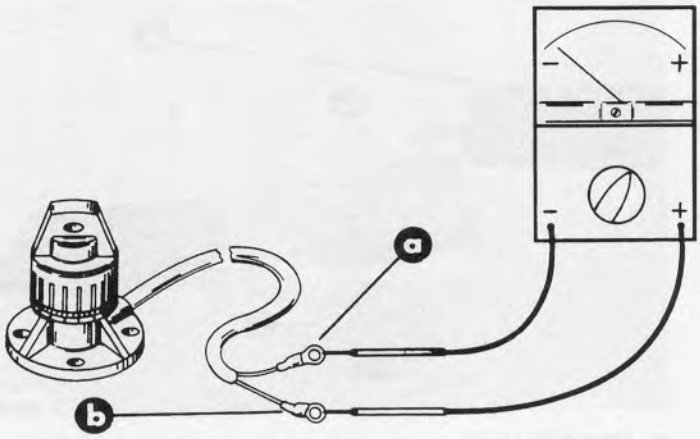
S - Key
W - Off
T - Continuity, B-A Terminals
V - Continuity, B-I Terminals
X - Run
Y - Continuity, B-C Terminals
Z - Start

Emergency Stop Switch

TESTING

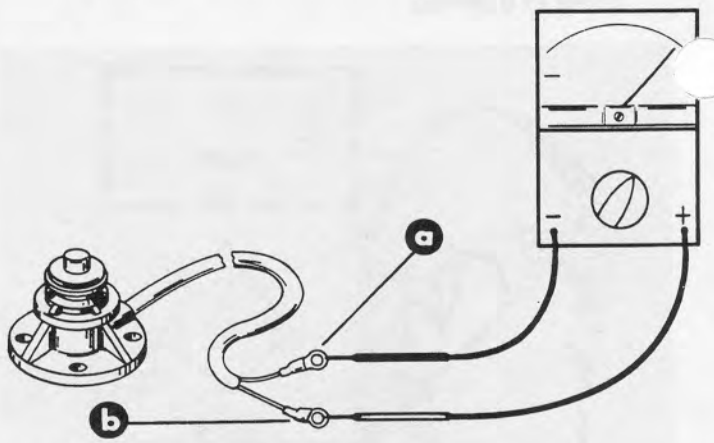
IMPORTANT: White lead must be taped back.

1. Remove leads from connections.
2. Using a test meter, check with the switch cap on, for continuity between black and green, no continuity can exist.



a - Black
b - Green

3. With cap off continuity must exist between black and green.



a - Black
b - Green

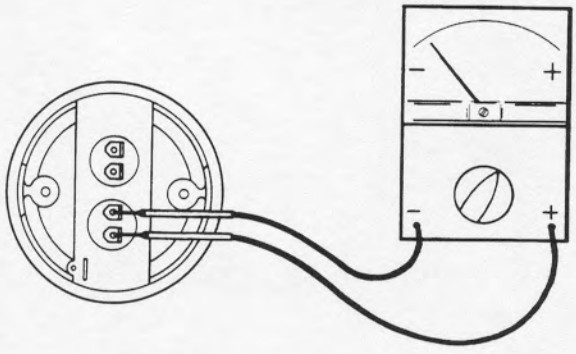
Start/Stop Panel

TESTING

⚠WARNING

Disconnect battery leads at battery before testing.

1. Disconnect battery leads.
2. Check for continuity between the terminals on the start switch with a continuity meter.



3. No continuity should exist.
4. Depress switch button and continuity should exist.
5. Check stop switch in the same manner.
6. If continuity exists when in the open (not depressed) state, replace panel button.

Audio Warning System

BUZZER

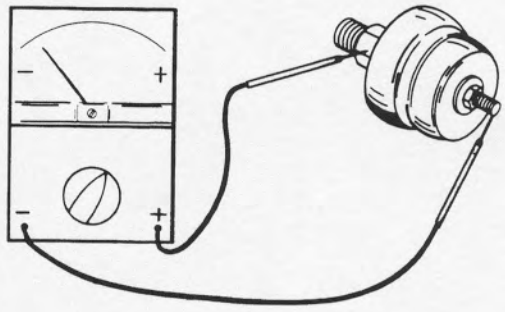
Testing

1. Turn key to on position (engine off).
2. Wait 7 to 14 seconds for horn to sound.

PRESSURE SWITCH

Testing

1. Remove wire from sender terminal.
2. Connect continuity meter between sender terminal and metal of sender case.
3. With engine not running, meter should indicate full continuity.
4. Start engine. With engine running and engine oil pressure above 6 PSI, meter should indicate NO continuity.

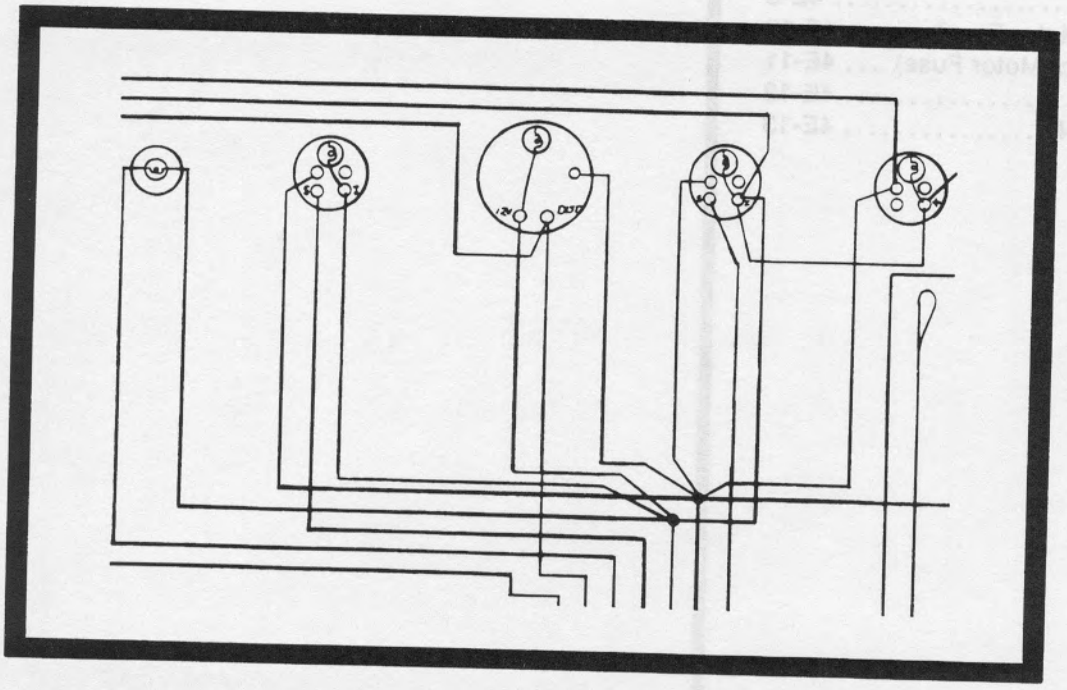


TEMPERATURE SWITCH

Testing

1. Remove wire from terminal.
2. Remove sender.
3. Connect continuity meter between sender terminal and metal case.
4. With sender cold no continuity should exist.
5. Heat sender to 190°-200°F (31°-34°C).
6. Continuity should exist.

ELECTRICAL SYSTEMS



WIRING DIAGRAMS

4

E

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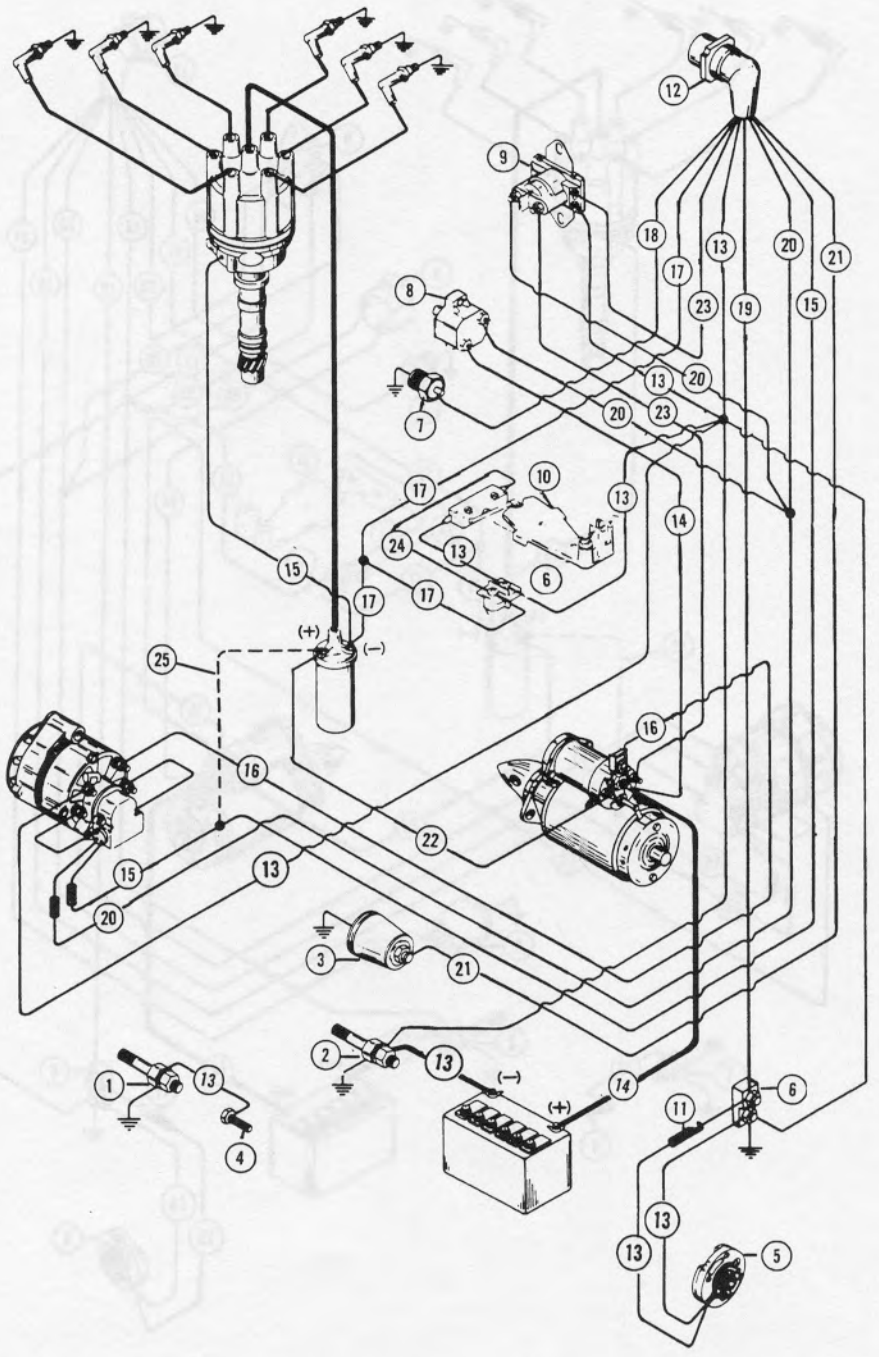
V-6 ENGINE WIRING WITH STARTER MOTOR FUSE

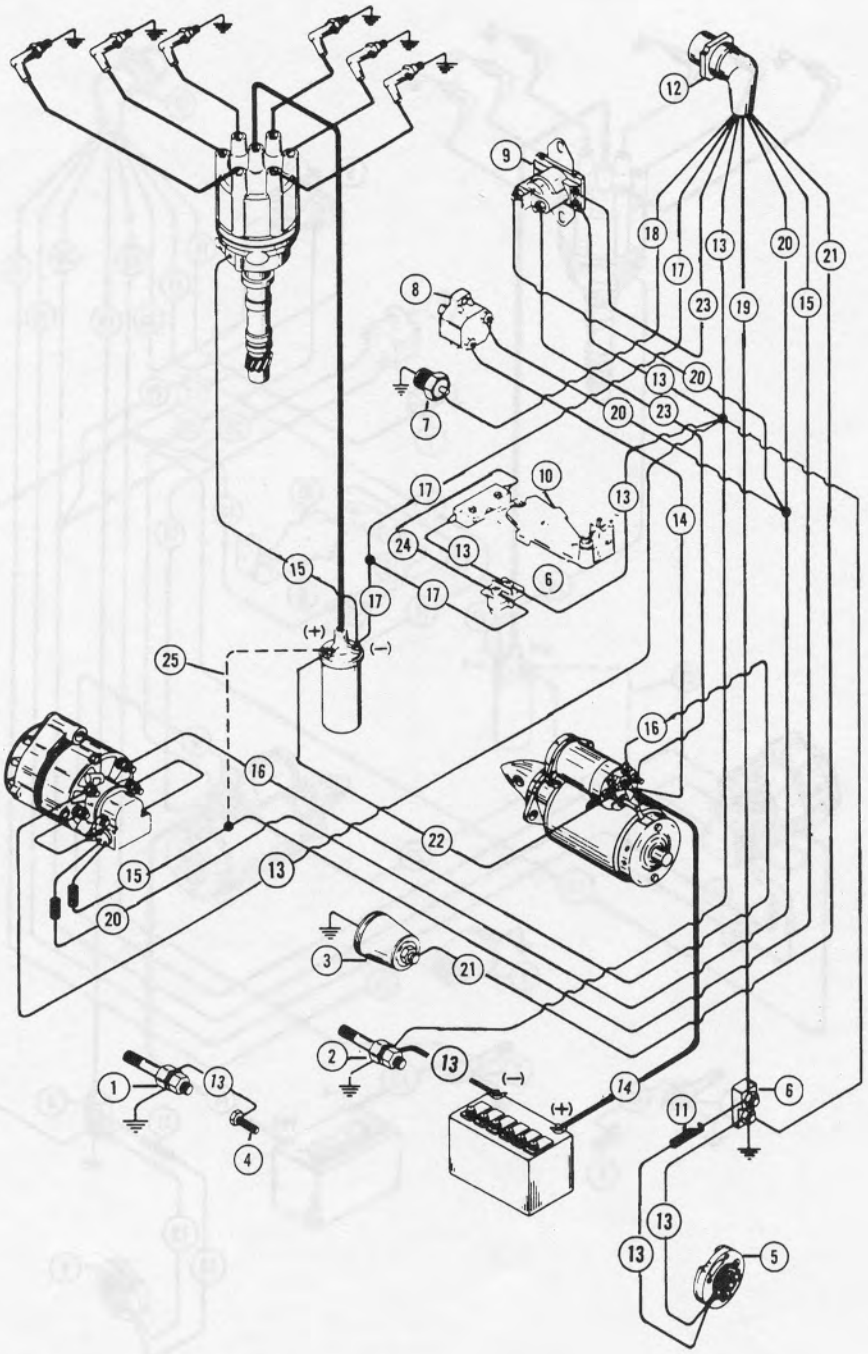
EARLIER MODELS



1 - Ground Stud on Engine Flywheel Housing
2 - Engine Ground Stud
3 - Oil Pressure Sender
4 - Ground Screw on Inner Transom Plate
5 - Trim Sender
6 - Terminal Block
7 - Water Temperature Sender
8 - Circuit Breaker
9 - Starter Slave Solenoid
10 - Shift Cutout Switch
11 - Brown Sleeve
12 - Wiring Harness
13 - Black
14 - Red
15 - Purple
16 - Orange
17 - Gray
18 - Tan
19 - Brown/White
20 - Red/Purple
21 - Light Blue
22 - Purple/Yellow
23 - Yellow/Red
24 - White/Green
25 - Purple Resistance Wire

V-6 ENGINE WIRING WITHOUT STARTER MOTOR FUSE

EARLIER MODELS



1 - Ground Stud on Engine Flywheel Housing
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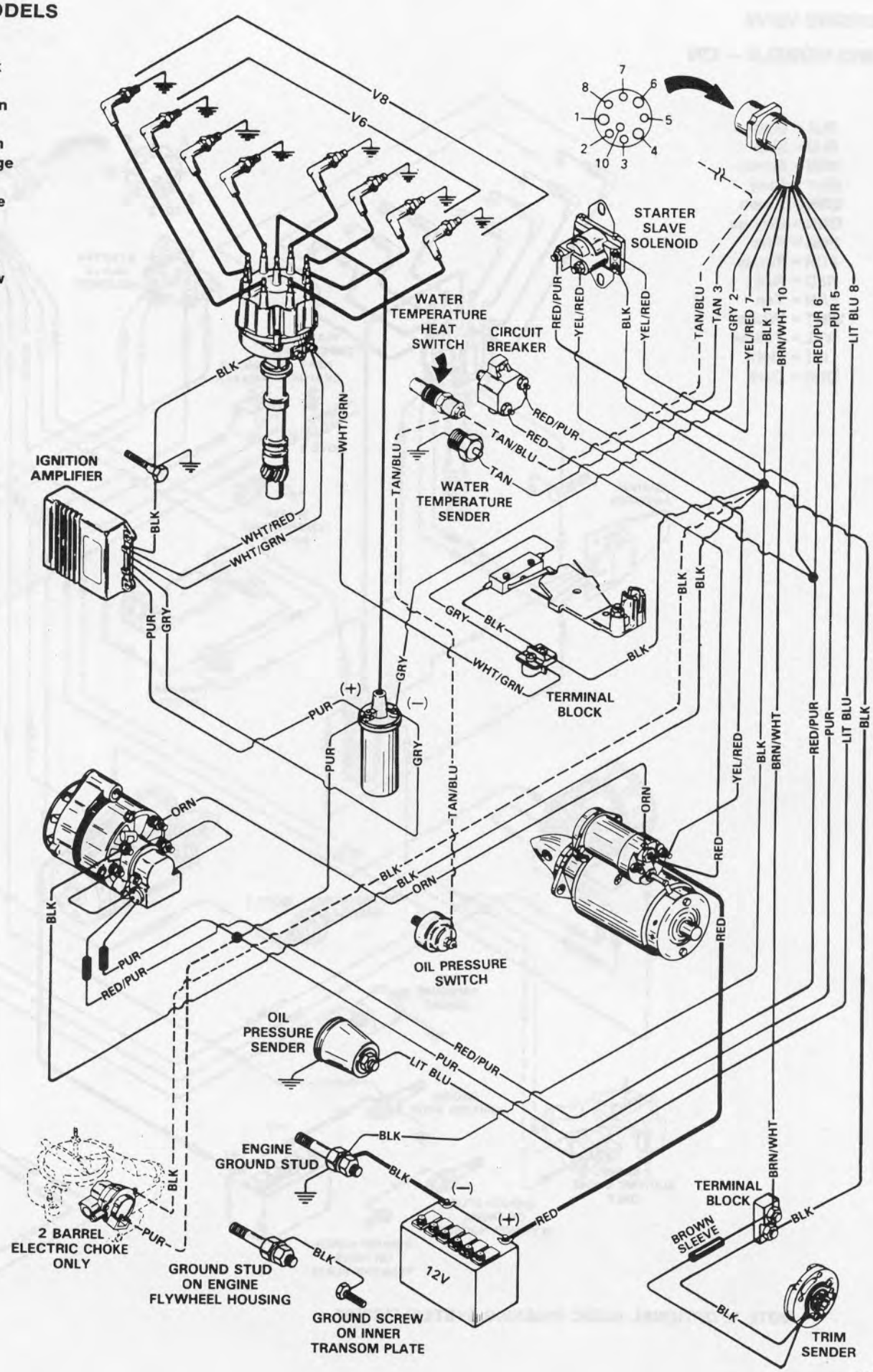
16 - Orange
17 - Gray
18 - Tan
19 - Brown/White
20 - Red/Purple
21 - Light Blue
22 - Purple/Yellow
23 - Yellow/Red
24 - White/Green
25 - Purple Resistance Wire

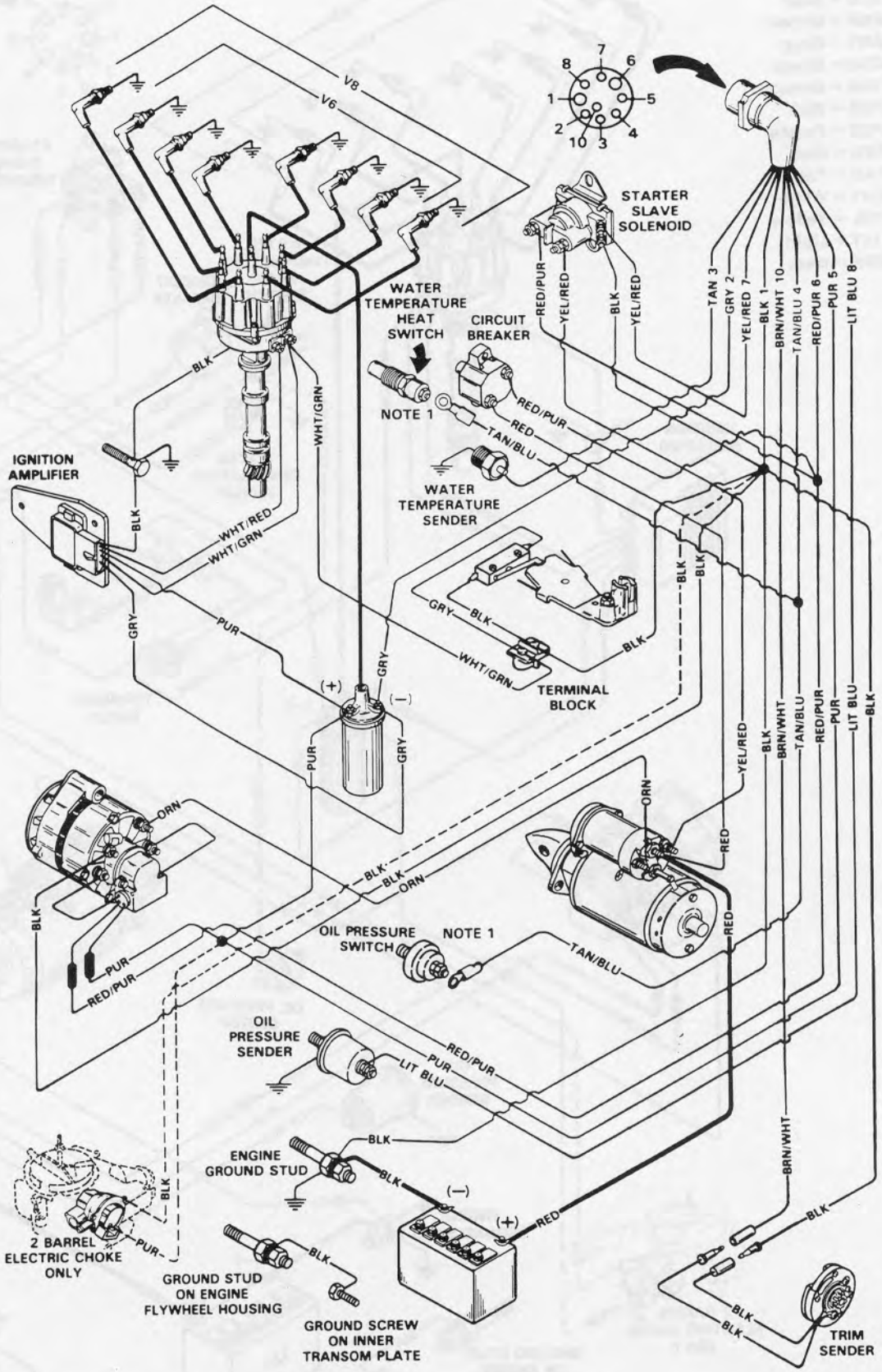
ENGINE V6/V8
PRE-1989 MODELS

BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark



24035

BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark



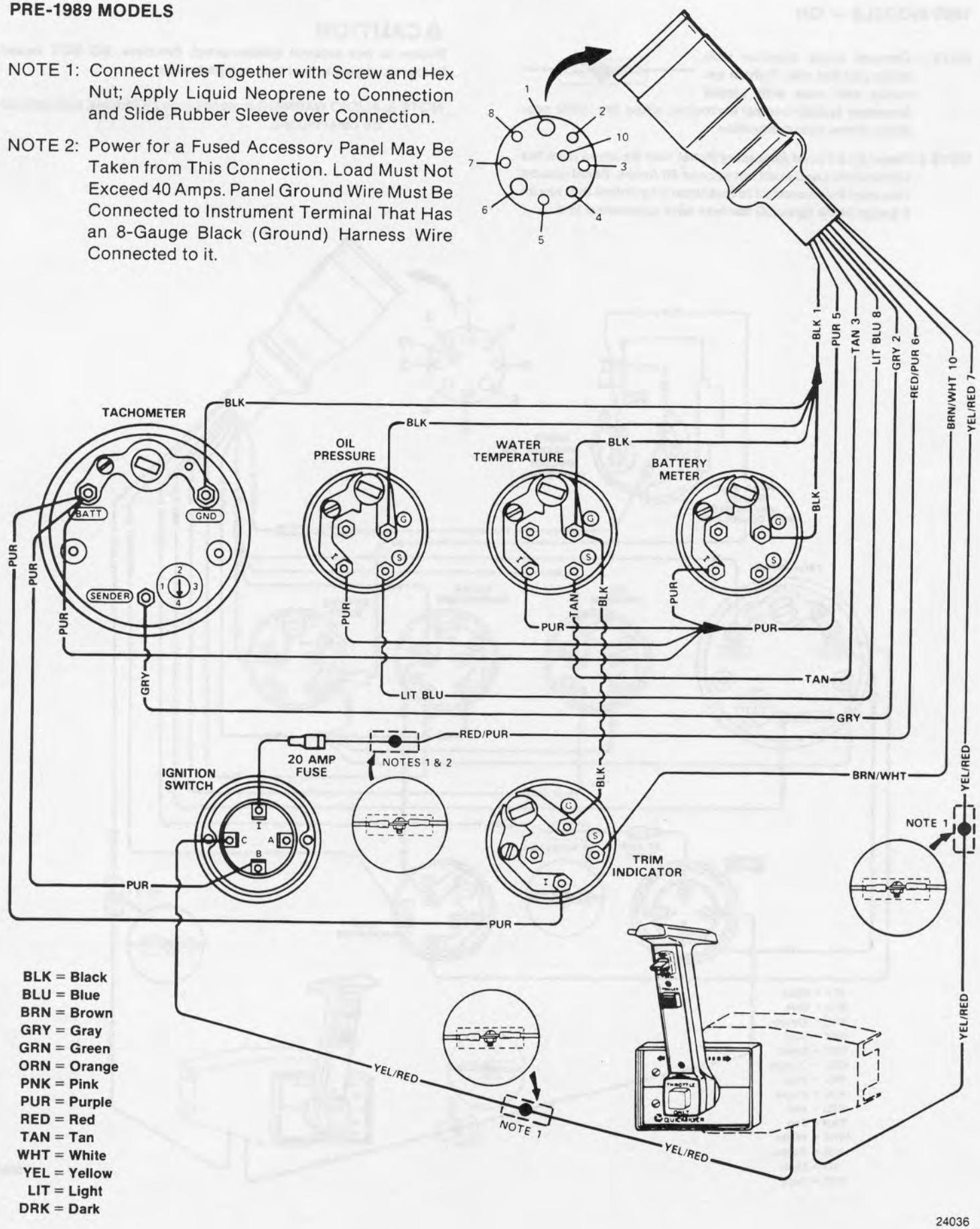
NOTE 1: OPTIONAL AUDIO WARNING SYSTEM CIRCUIT

QUICKSILVER INSTRUMENTATION (WITH RING TERMINALS)

PRE-1989 MODELS

NOTE 1: Connect Wires Together with Screw and Hex Nut; Apply Liquid Neoprene to Connection and Slide Rubber Sleeve over Connection.

NOTE 2: Power for a Fused Accessory Panel May Be Taken from This Connection. Load Must Not Exceed 40 Amps. Panel Ground Wire Must Be Connected to Instrument Terminal That Has an 8-Gauge Black (Ground) Harness Wire Connected to it.



24036

QUICKSILVER INSTRUMENTATION WIRING DIAGRAM (WITH RING TERMINAL)

1989 MODELS — ON

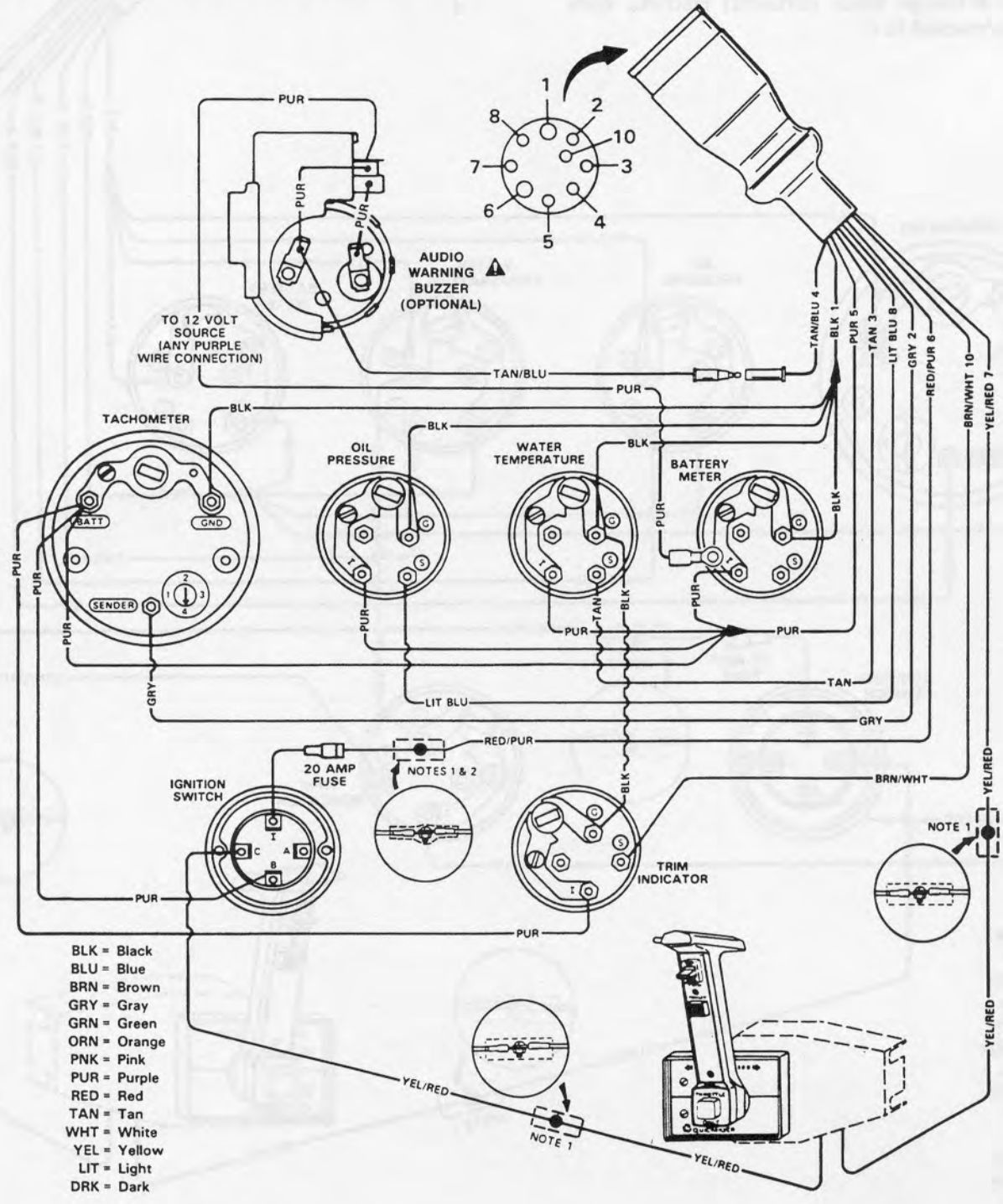
NOTE 1: Connect wires together with screw and hex nut. Tighten securely and coat with Liquid Neoprene to help control corrosion; when dry, slide neoprene sleeve over connection.

NOTE 2: Power for a Fused Accessory Panel may be taken from this connection. Load must not exceed 40 Amps. Panel ground wire must be connected to Instrument Terminal that has an 8-gauge black (ground) harness wire connected to it.

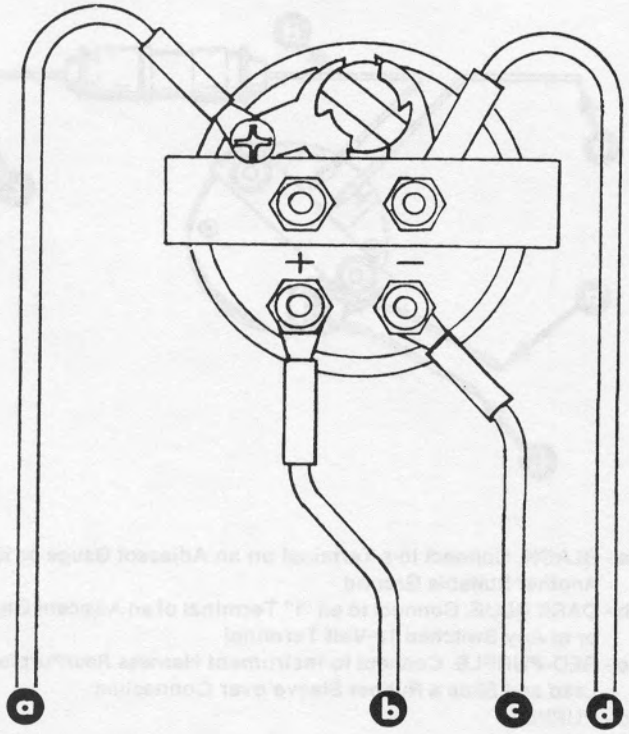
⚠CAUTION

Buzzer is not external ignition-proof, therefore, DO NOT mount buzzer in engine or fuel tank compartments.

NOTE 3: AUDIO WARNING is standard on LX Models, and optional on other models.



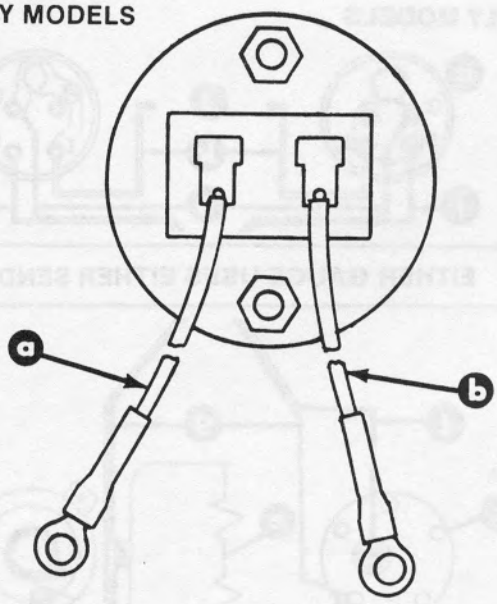
Ammeter Gauge



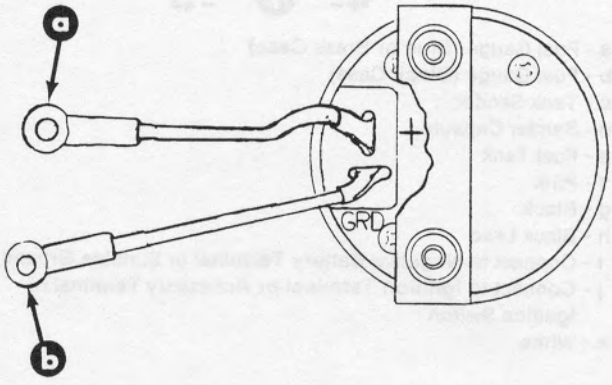
a - To 12-Volt Switched Terminal on Adjacent Gauge or to Accessory Side of Ignition Switch
b - To "Batt" Side of Alternator
c - To Battery or to "Batt" Side of Starter Solenoid
d - To Ground

Cruiselog

EARLY MODELS



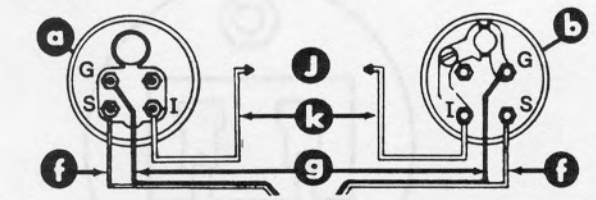
LATER MODELS



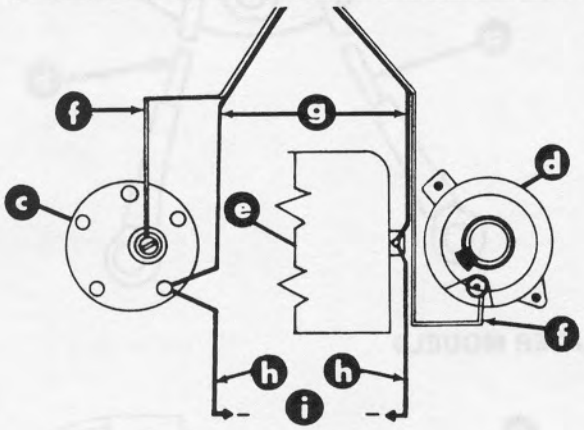
a - Purple, Connect to Ignition Switch Activated 12-Volt Positive (+) Source
b - Black, Connect to Negative (-) Ground

Fuel Gauge and Sender

EARLY MODELS

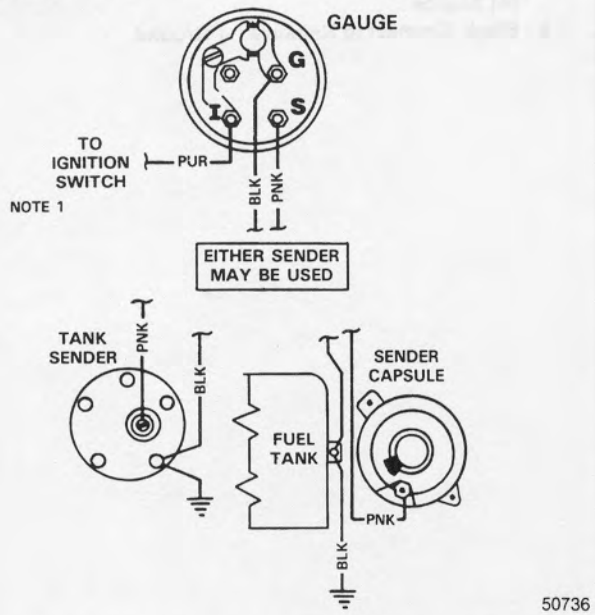


EITHER GAUGE USES EITHER SENDER.



a - Fuel Gauge (Blue or Brass Case)
b - Fuel Gauge (Black Case)
c - Tank Sender
d - Sender Capsule
e - Fuel Tank
f - Pink
g - Black
h - Black Lead
i - Connect to Negative Battery Terminal or Suitable Ground
j - Connect to Ignition Terminal or Accessory Terminal of Ignition Switch
k - White

LATER MODELS



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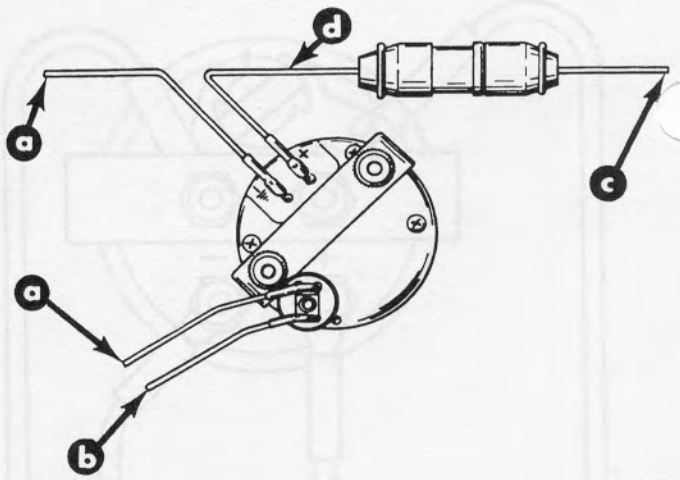
NOTE 1. PURPLE WIRE CONNECTS TO "IGNITION" TERMINAL OR "ACCESSORY" TERMINAL OF IGNITION SWITCH.

Quartz Clock

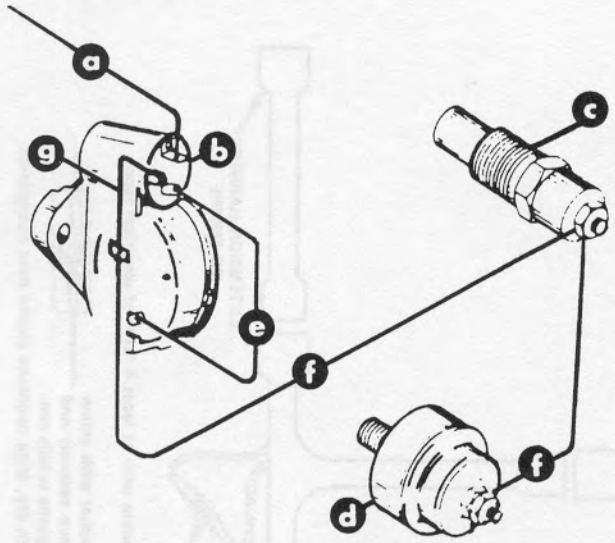


140-H

a - BLACK, Connect to a Terminal on an Adjacent Gauge or to Another Suitable Ground
b - DARK BLUE, Connect to an "I" Terminal of an Adjacent Gauge or to Any Switched 12-Volt Terminal
c - RED-PURPLE, Connect to Instrument Harness Red/Purple Lead and Slide a Rubber Sleeve over Connection
d - PURPLE

Audio Warning System

EARLY MODELS



a - To 12V Source - Purple
b - Audio Warning Buzzer
c - Water Temperature Heat Switch
d - Oil Pressure Switch
e - Red
f - Tan-Blue
g - Purple

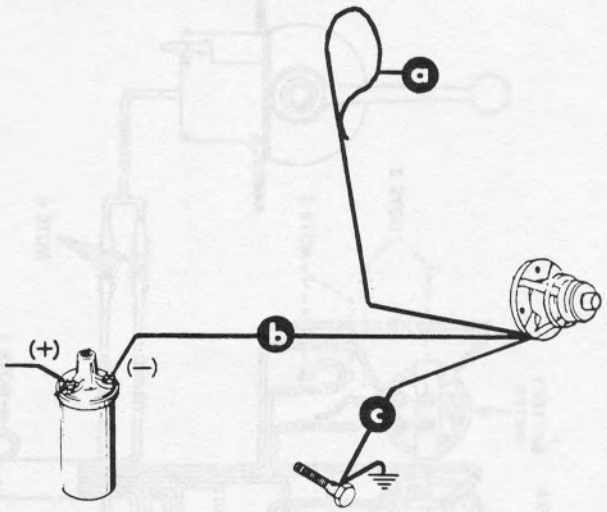
⚠WARNING
Buzzer is not external ignition-proof, therefore, DO NOT mount buzzer in engine or fuel tank compartments.

LATER MODELS

See "Instrumentation Wiring Diagram, 1989 Models — ON," following (this Section).

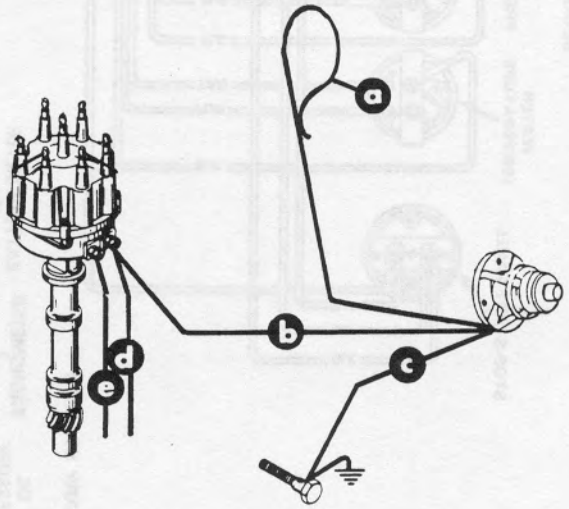
Emergency Stop Switch

BREAKER POINT IGNITION



a - White, Tape Back
b - Black, to Negative on Ignition Coil
c - Green, to Ground

HEI (Thunderbolt) IGNITION



a - White, Tape Back
b - Green, to Distributor
White, Green Terminal
c - Black, to Ground
d - White-Green
e - White-Red

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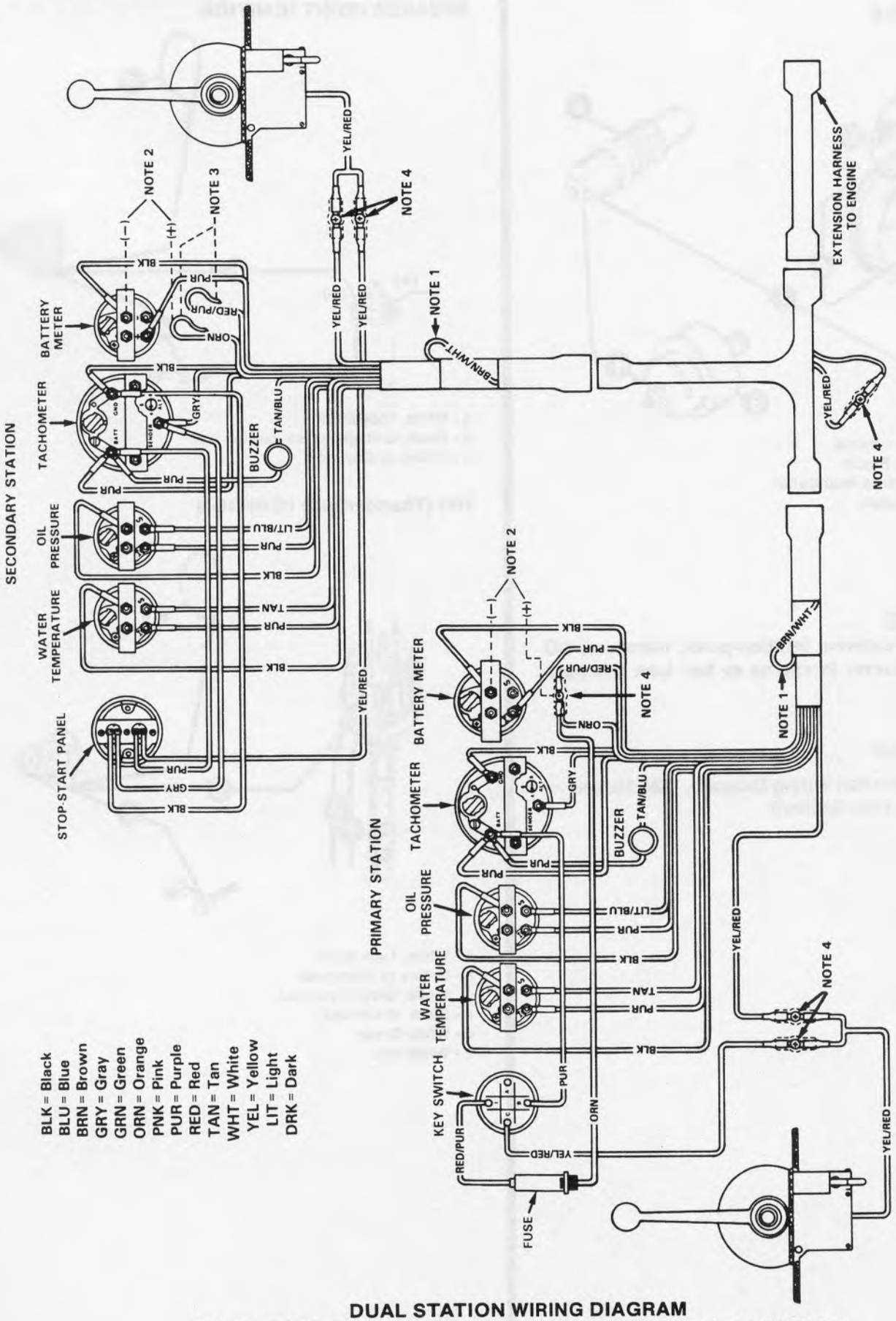


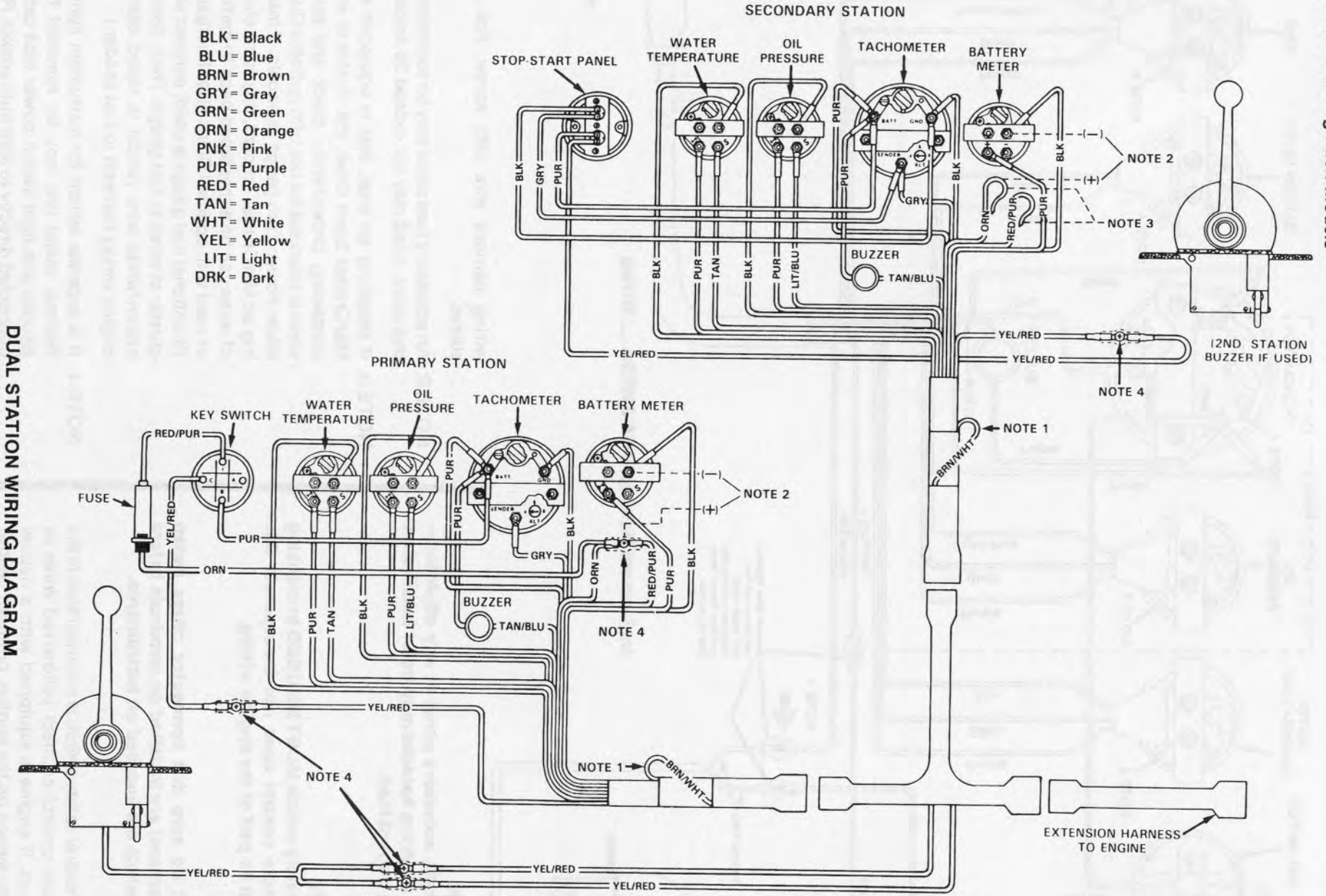
NOTE 1. Brown/white wire is taped back at instrument end. If installing on boat, that is equipped with MerCruiser Stern Drive, brown/white wire is connected to trim sender terminal block. If installing on MerCruiser Inboard, brown/white wire is taped back at engine end, or it may be used for an accessory (limit 5 amps.).

NOTE 2. An accessory fuse panel may be connected at this location. The combined current draw of the primary station and secondary station MUST NOT exceed 35 amps.

NOTE 3. Tape back and insulate with at least 4 layer of electrical tape.

NOTE 4. Connect wires together with screw and hex nut. Tighten securely and coat with liquid neoprene to help control corrosion; when dry, slide neoprene sleeve over connection.

DUAL STATION WIRING DIAGRAM
USING A NEUTRAL SAFETY SWITCH IN BOTH REMOTE CONTROLS
(Battery Meter Circuit)



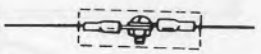
DUAL STATION WIRING DIAGRAM
USING A NEUTRAL SAFETY SWITCH IN ONLY ONE REMOTE CONTROL
(Battery Meter Circuit)

NOTE 1. Brown/white wire is taped back at instrument end. If installing on boat, that is equipped with MerCruiser Stern Drive, brown/white wire is connected to trim sender terminal block. If installing on MerCruiser Inboard, brown/white wire is taped back at engine end, or it may be used for an accessory (limit 5 amps.).

NOTE 2. An accessory fuse panel may be connected at this location. The combined current draw of the primary station and secondary station MUST NOT exceed 35 amps.

NOTE 3. Tape back and insulate with at least 4 layer of electrical tape.

NOTE 4. Connect wires together with screw and hex nut. Tighten securely and coat with liquid neoprene to help control corrosion; when dry, slide neoprene sleeve over connection.



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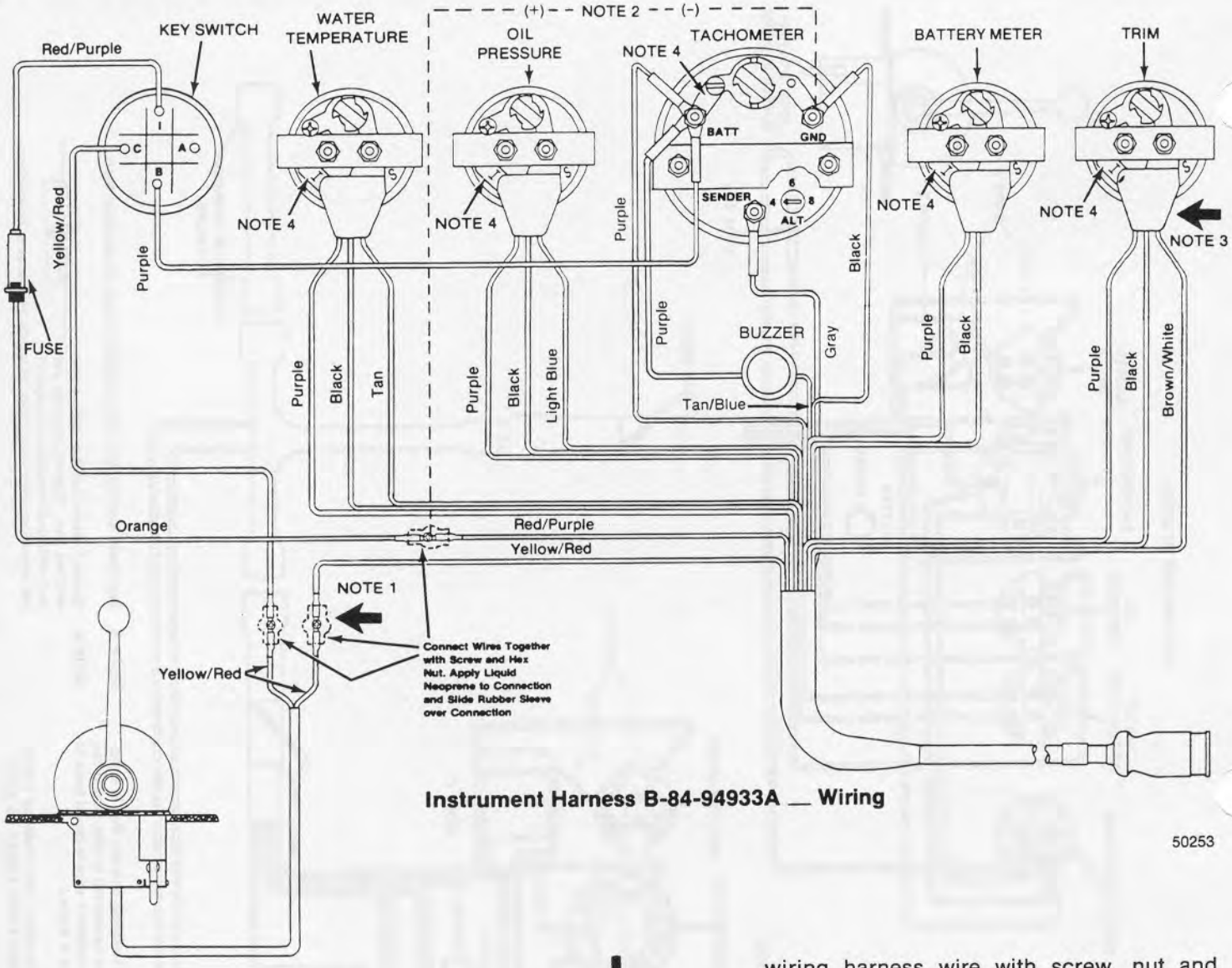
INSTRUMENTATION (WITH CONNECTOR PLUG)



Instrument Harness B-84-94933A __ Wiring

50253

⚠CAUTION
DO NOT connect accessory panel at any other location, as wires in wiring harness may be of insufficient size to handle current load.

⚠CAUTION
Neutral start safety switch MUST BE USED in cranking circuit. If remote control does not incorporate this switch, it must be part of the engine wiring.

IMPORTANT: Be sure that connector plugs (when connecting harness) are installed on terminals before mounting brackets are installed on instruments.

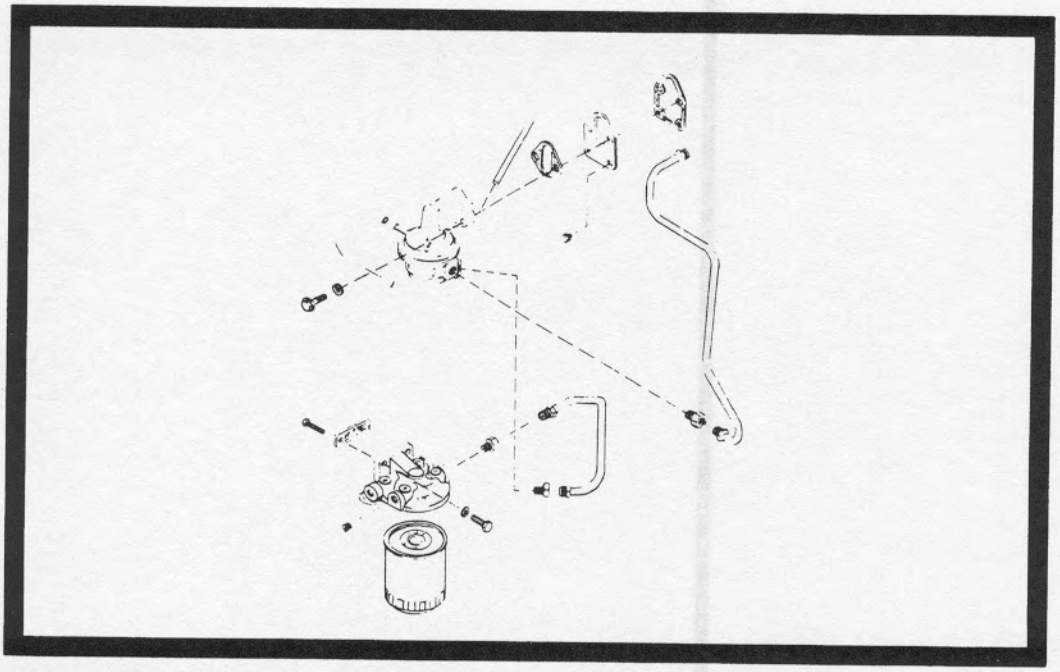
NOTE 1: If a neutral safety switch is incorporated in the remote control connect yellow/red wires as shown. If engine is equipped with a neutral safety switch on the engine, connect yellow/red ignition switch wire directly to yellow/red wiring harness wire with screw, nut and sleeve.

NOTE 2: An accessory fuse panel may be connected at this point. Load may not exceed 35 amps.

NOTE 3: If installing on boat, that is equipped with MerCruiser Stern Drive, the cluster of wires containing brown/white, black and purple wires is intended for use with optional Quicksilver Power Trim gauge as shown. If installing on MerCruiser Inboard, this same cluster of wires can be either taped back to harness, or used with optional Quicksilver Fuel gauge. [If optional fuel gauge is used, connect same cluster of wires to fuel gauge. Then, connect brown/white wire (which is taped back to engine wiring harness) to fuel sender.]

NOTE 4: If a separate switch for instrument lights is desired, metal link may be removed from gauges and light switch power lead can be connected directly to light bulb socket. Refer to instructions which accompany instruments.

FUEL SYSTEM



FUEL DELIVERY SYSTEM

5

A

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Tools/Lubricants/Sealants

TOOLS OBTAINED LOCALLY
Fuel Pressure Gauge

LUBRICANTS/SEALANTS	
92-34227-1	Quicksilver Perfect Seal
92-825265A1	Quicksilver Needle Bearing Assembly Lubricant

SEALANTS OBTAINED LOCALLY
Loctite Pipe Sealant with Teflon

Precautions

⚠WARNING

ALWAYS disconnect battery cables from battery BEFORE working on fuel system to prevent fire or explosion.

⚠CAUTION

DO NOT operate engine without cooling water being supplied to seawater pickup pump or pump impeller will be damaged, and subsequent overheating damage may result.

⚠WARNING

Be careful when changing fuel system components; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF." DO NOT smoke or allow sources of spark or flame in the area while working. Wipe up any spilled fuel immediately.

⚠WARNING

Make sure that no fuel leaks exist, before closing engine hatch.

Fuel Delivery System

Recommendations

⚠WARNING

Boating industry standards (BIA, ABYC, etc.) federal standards and Coast Guard regulations MUST BE adhered to when installing fuel delivery system.

When designing and installing fuel delivery system, the following information MUST BE observed:

1. Fuel tank should be mounted below carburetor level, if possible. If tank is mounted above carburetor level, gravity feed may cause carburetor fuel inlet needle to unseat, and flooding may result.
2. Fuel pickup should be at least 1 in. (25mm) from the bottom of the fuel tank to prevent picking up water or other impurities.
3. Fuel lines used MUST BE Coast Guard approved (USCG type A) and MUST NOT BE SMALLER THAN 3/8 in. (9.5mm) ID. On installations where long lines or numerous fittings are required, larger size lines should be used.
4. **Dual installations:** It is best to use a fuel pickup and supply line for each engine. If a single pickup and line is used, fittings and line must not be smaller than 3/8 in. (10mm) ID.
5. Fuel line should be installed free of stress and firmly secured to prevent vibration and/or chafing.
6. Sharp bends in fuel line should be avoided.
7. A flexible fuel line must be used to connect fuel line to engine to absorb deflection when engine is running.

Description

The fuel system consists of a fuel tank(s), a water separating fuel filter (if so equipped), a fuel pump, and a carburetor.

The fuel is stored in the fuel tank. When the engine is cranking or running, fuel is drawn from the fuel tank, through the water separating filter (if so equipped), by a mechanically operated fuel pump. The fuel pump is operated by the engine camshaft.

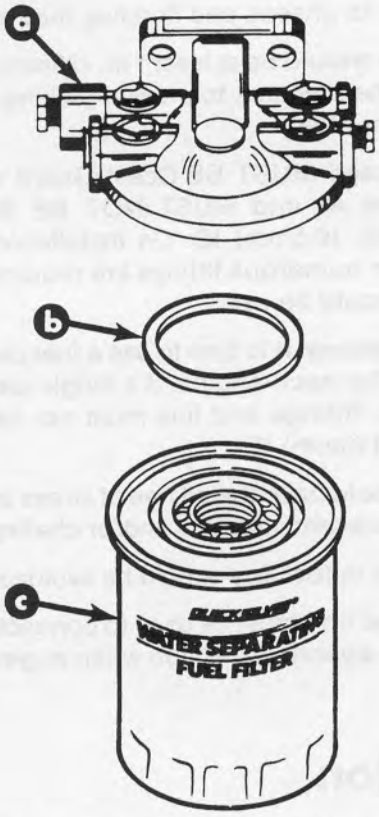
The fuel is pushed through the fuel pump to the carburetor where it is metered and fed to the engine.

Water Separating Fuel Filter (If So Equipped)

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

The water separating fuel filter assembly is available for engines not so equipped.

The fuel filter assembly consists of the fuel filter bracket and filter element.



a - Filter Mounting Bracket
b - Filter Element
c - Sealing Ring

Fuel Supply Connection

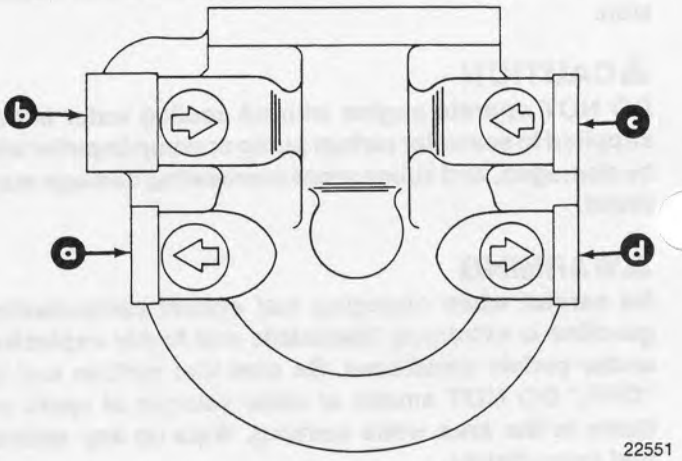
⚠CAUTION

Apply #592 Loctite Pipe Sealant with Teflon to threads of fuel inlet line connector. DO NOT USE TEFLON TAPE. To prevent cracking the casting and/or fue leaks, turn inlet connector in by hand until finger tight, then tighten connector to 1-3/4 to 2-1/4 turns with wrench. DO NOT OVER TIGHTEN. Inspect for fuel leaks.

A flexible fuel line must be used to connect fuel line to engine to absorb deflection when engine is running.

IMPORTANT: If installing water separating fuel filter as an option, filter should be located between fuel tank and fuel pump. Also fuel inlet and outlet lines must be connected correctly for filter to work properly. Follow instructions supplied with water separating fuel filter kit.

WATER SEPARATING FUEL FILTER ADAPTOR BRACKET



a - Fuel Outlet if "C" is the Inlet
b - Fuel Inlet if "D" is the Outlet
c - Fuel Inlet if "A" is the Outlet
d - Fuel Outlet if "B" is the Inlet

Replacement

1. Disconnect negative and positive battery leads from battery.
2. Remove filter element from mounting base by turning counterclockwise. You may need a filter wrench to break element loose.

IMPORTANT: Element cannot be cleaned and reused, it must be replaced.

3. Lubricate sealing ring with engine oil.
4. Install new element. Tighten securely by hand.
5. Reinstall battery leads, start engine (making sur water is supplied to cooling system), and check for fuel leaks.

Parts List

PART NUMBER	ITEM DESCRIPTION/SIZE	QTY.
32-806418A1	Fuel Line	1
35-805926	Fuel Filter	1
54-92338	J-Clip	1

Torque Specification

ITEM DESCRIPTION	TORQUE
All Kit Fittings	180 lb. in. (20 N·m)

⚠ WARNING

Always disconnect battery cables from battery BEFORE working on fuel system. Accidental sparks can ignite fuel vapors.

⚠ WARNING

Gasoline is flammable and explosive. DO NOT smoke or allow any source of spark or flame in area while installing fuel line kit. Wipe up any spilled fuel immediately.

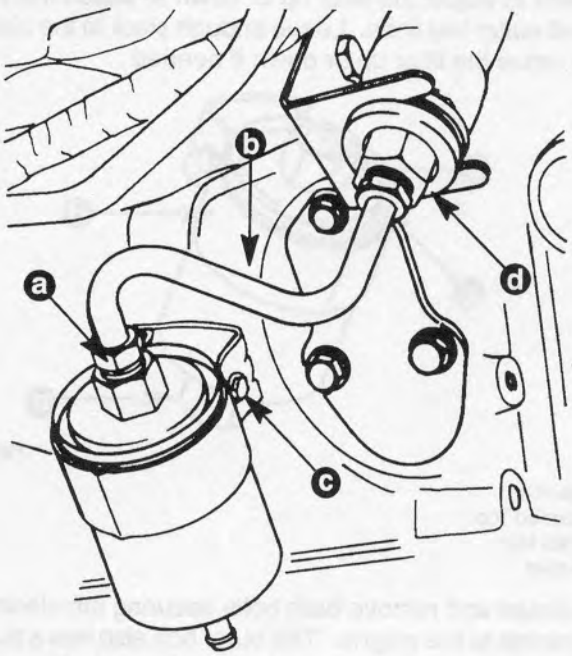
Installation Instructions

⚠ WARNING

Plug fuel supply hose after removal to prevent fuel from leaking into boat. Leaking fuel may burn or explode.

Preparation

1. Disconnect battery cables.
2. Close fuel shut-off valve, if so equipped. Or, disconnect the fuel hose from the fuel filter and plug the hose suitably.
3. Unscrew the outlet fuel line fitting from the filter. Stabilize the filter by holding the fuel filter nut with a second wrench.
4. Loosen the fuel line fitting connected to the fuel pump. Hold the fuel pump with a second wrench. Then, move the fuel line out of the way.
5. Loosen the bracket bolt holding the fuel filter, and slide the filter out the top of the clamp.



71293

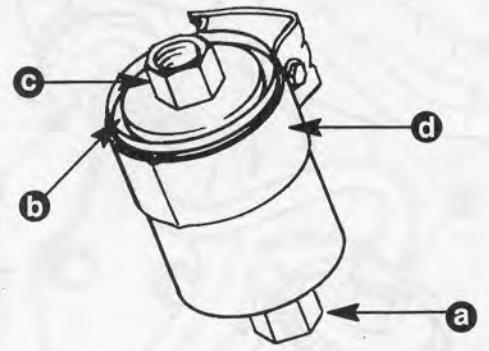
a - Outlet Fuel Line Fitting
b - Outlet Fuel Line
c - Bracket Screw
d - Fuel Pump

Installation

⚠ CAUTION

Avoid damage to electric fuel pump. Securely hold fuel pump fitting with suitable wrench when tightening fuel line fitting.

1. Slide the new filter into the clamp. Ensure that the inlet nut is on bottom and the outlet nut is on top. You may need to adjust the filter up or down to attach the inlet and outlet fuel lines. Leave enough slack in the clamp to move the filter up or down if needed .



73309

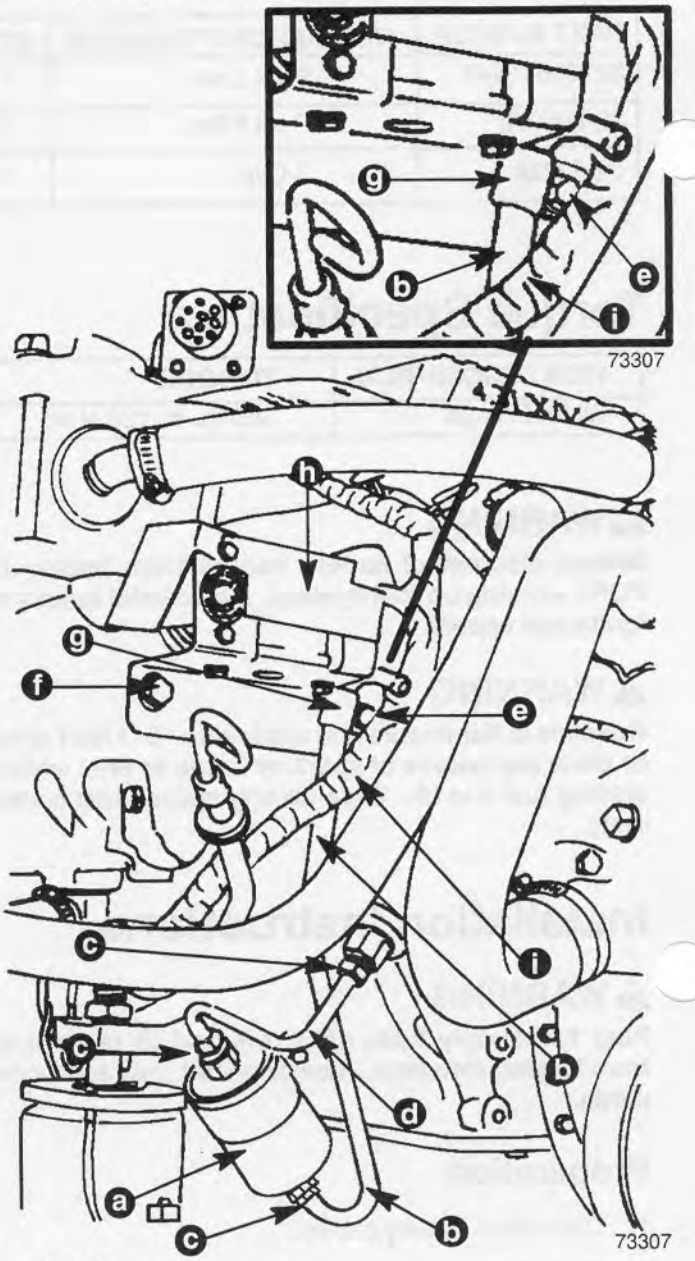
a - Inlet Nut
b - Indented Top
c - Outlet Nut
d - Bracket

2. Loosen and remove both bolts securing the electrical bracket to the engine. The outer bolt also has a bushing. Now, move the electrical bracket out of the way.
3. Move the outlet fuel line back into position and attach it to the filter. You might need to disconnect the fitting attached to the fuel pump. First, tighten the fittings finger tight. Then, torque the fittings attached to the fuel filter and the pump to specifications.
4. Route the inlet fuel line behind the wiring harness.
5. Attach the inlet fuel line fitting to the filter. Tighten finger tight.
6. Attach the J-clip to the fuel line.
7. Move the electrical bracket back into place.
8. Install the inner electrical bracket bolt so that the bolt holds both the J-clip and the electrical bracket to the engine. DO NOT completely tighten the bolt.
9. Insert the outer electrical bracket bolt and bushing. Tighten bolt completely.
10. Securely tighten the inner electrical bracket bolt.
11. Torque fuel line fittings to specifications, 180 lb. in. (20 N·m). Use a second wrench to hold the fuel filter and fuel pump.
12. Tighten bracket screw.
13. Attach fuel hose to inlet fuel line using hose clamp. Tighten securely with hose clamp.

⚠ WARNING

Avoid fuel leakage. Ensure that the fuel line DOES NOT contact the electric fuel pump lower mounting bracket.

14. Reconnect battery cables.



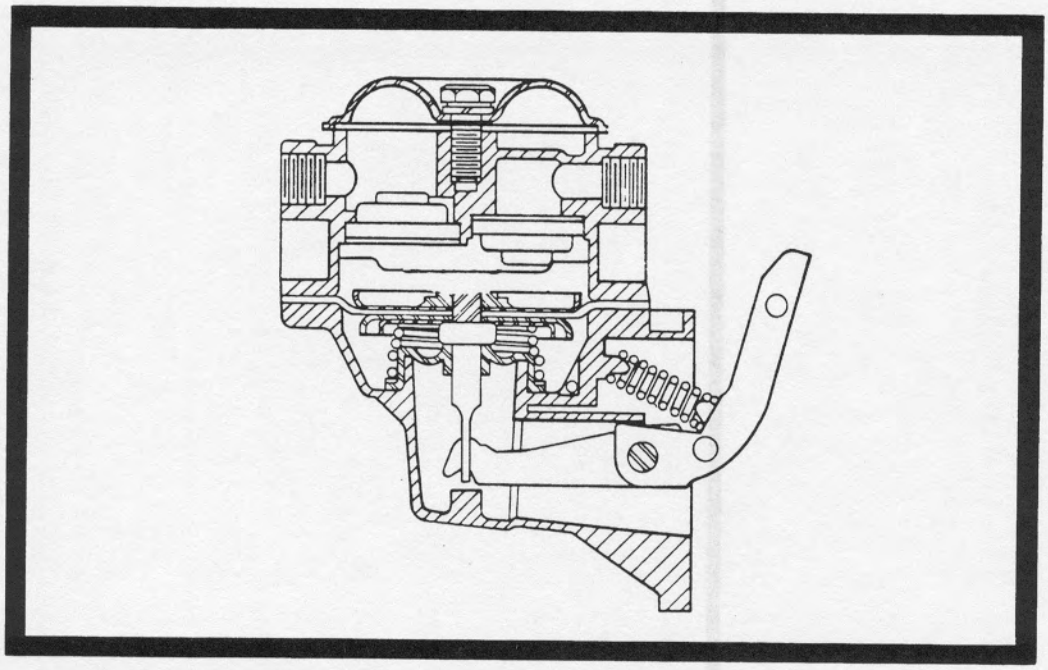
a - Fuel Filter
b - Inlet Fuel Line
c - Fitting
d - Outlet Fuel Line
e - Inner Electrical Bracket Bolt
f - Outer Electrical Bracket Bolt
g - J-clip
h - Electrical Bracket
i - Electrical Wiring Harness

⚠ WARNING

Ensure that no fuel leaks exist before closing engine hatch.

15. After installation and upon first starting, check fuel line fitting and hose connections for leakage.

FUEL SYSTEMS



FUEL PUMP

5

B

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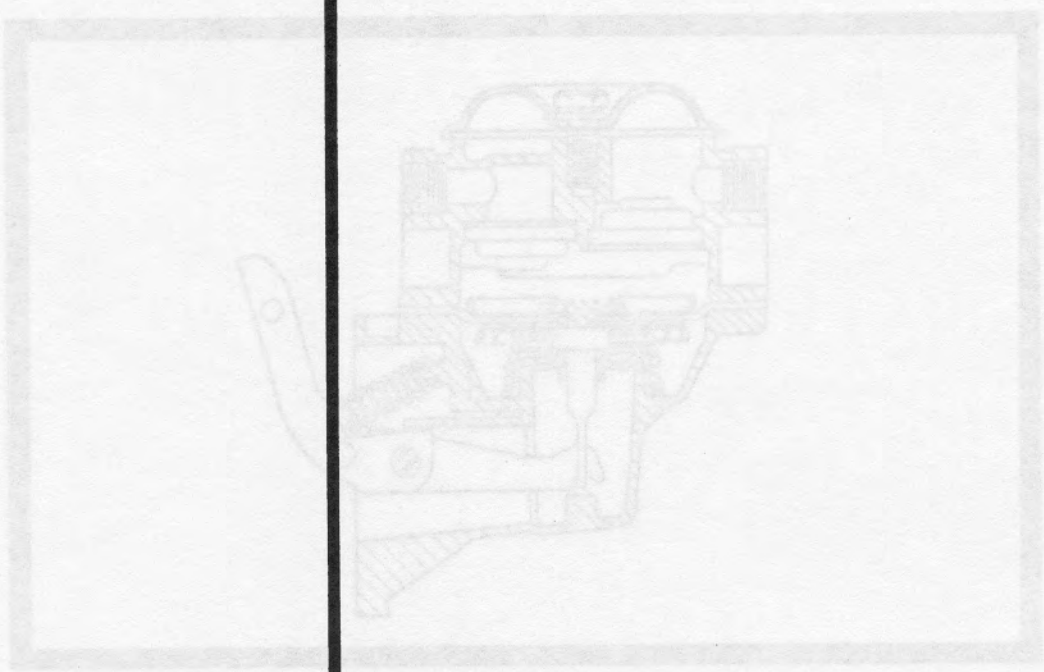
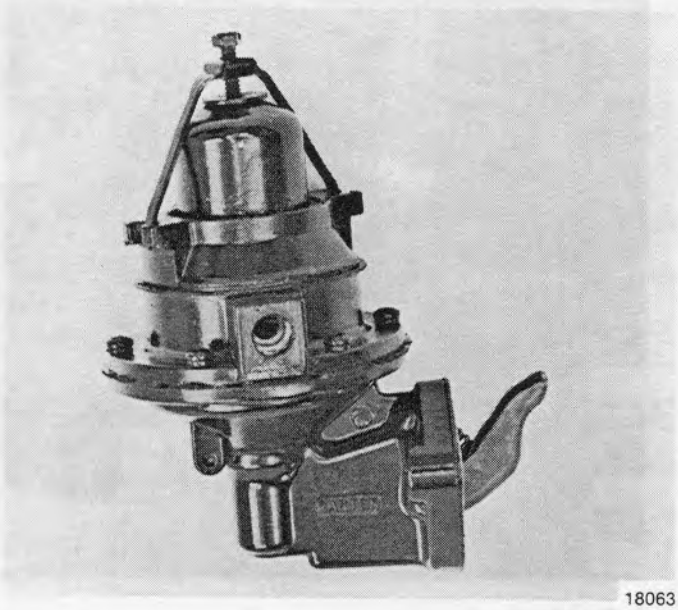


Identification

CARTER FUEL PUMP

Replaceable fuel filter element, non-replaceable diaphragm.



18063

Electric

REPLACEMENT PARTS

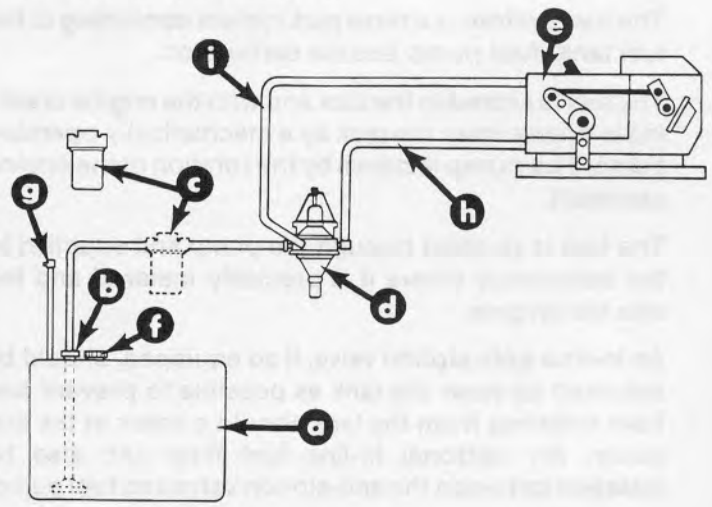
⚠WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

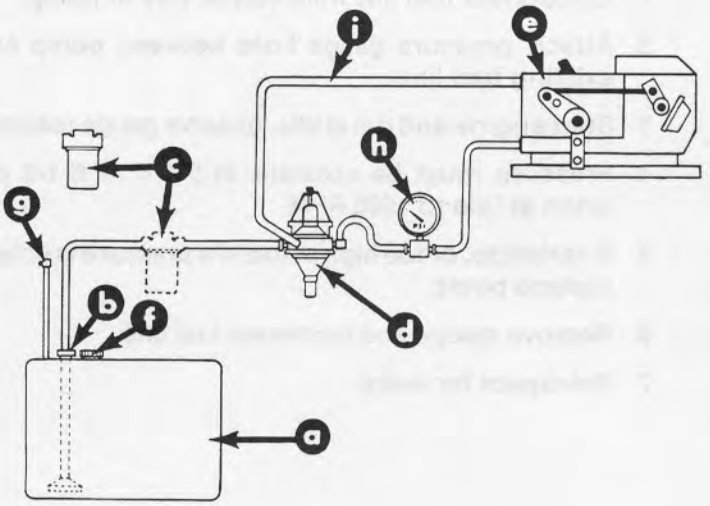
Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Many of the engine mechanical components are designed for marine applications. Unlike automotive engines, marine engines are subjected to extended periods of heavy load and wide-open-throttle operation, and therefore, require heavy-duty components. Special marine engine parts have design and manufacturing specifications which are required to provide long life and dependable performance. Marine engine parts also must be able to resist the corrosive action of salt and brackish water that will rust or corrode standard automotive parts within a short period of time.

SYSTEM COMPONENTS



a - Fuel Tank
b - Anti-Siphon Valve
c - Water Separating Fuel Filter (Optional)
d - Fuel Pump
e - Carburetor
f - Fuel Filler
g - Vent Hose
h - Fuel Line
i - Sight Tube



With Pressure Test Kit Installed

a - Fuel Tank
b - Anti-Siphon Valve
c - Water Separating Fuel Filter (Optional)
d - Fuel Pump
e - Carburetor
f - Fuel Filler
g - Vent Hose
h - Pressure Test Gauge (installed in fuel line)
i - Sight Tube

SYSTEM DESCRIPTION

The fuel system is a three part system consisting of the fuel tank, fuel pump and the carburetor.

The fuel is stored in the tank and with the engine cranking is drawn from the tank by a mechanically operated pump. The pump is driven by the rotation of the engine camshaft.

The fuel is pushed through the pump and supplied to the carburetor where it is precisely metered and fed into the engine.

An in-line anti-siphon valve, if so equipped, should be mounted as near the tank as possible to prevent fuel from draining from the tank should a break in the line occur. An optional in-line fuel filter can also be installed between the anti-siphon valve and fuel pump.

PRESSURE TEST

⚠CAUTION

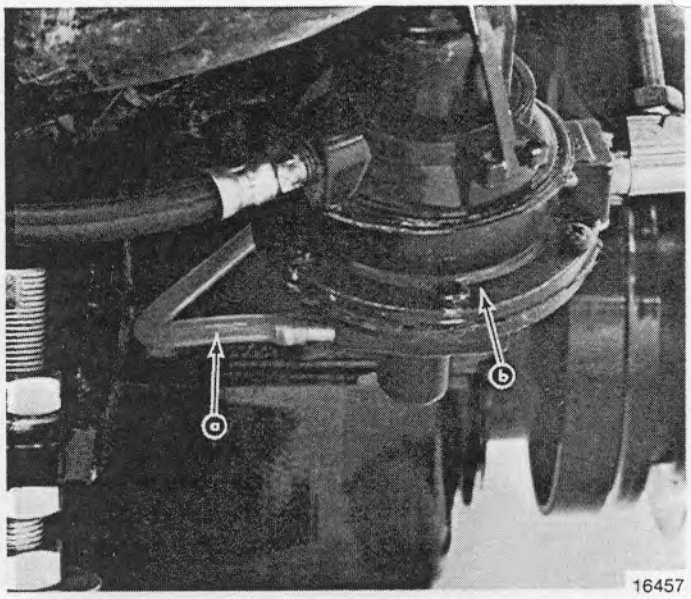
Before servicing the fuel system, always disconnect BOTH battery terminals. This will prevent accidental shorting which may ignite fuel that is spilled when fuel lines are disconnected.

1. Disconnect fuel line from output side of pump.
2. Attach pressure gauge lines between pump and existing fuel line.
3. Start engine and run at idle, observe gauge reading.
4. Pressure must be constant at 5-1/4 to 6-1/2 psi when at idle to 1000 RPM.
5. If variation, or too high or too low pressure is noted, replace pump.
6. Remove gauge and reconnect fuel line.
7. Reinspect for leaks.

SIGHT TUBE INSPECTION

The fuel pump is equipped with a sight tube to give you visible evidence of a ruptured fuel pump diaphragm.

IF FUEL IS VISIBLE IN TUBE, REPLACE FUEL PUMP IMMEDIATELY.



16457

a - Sight Tube
b - Fuel Pump

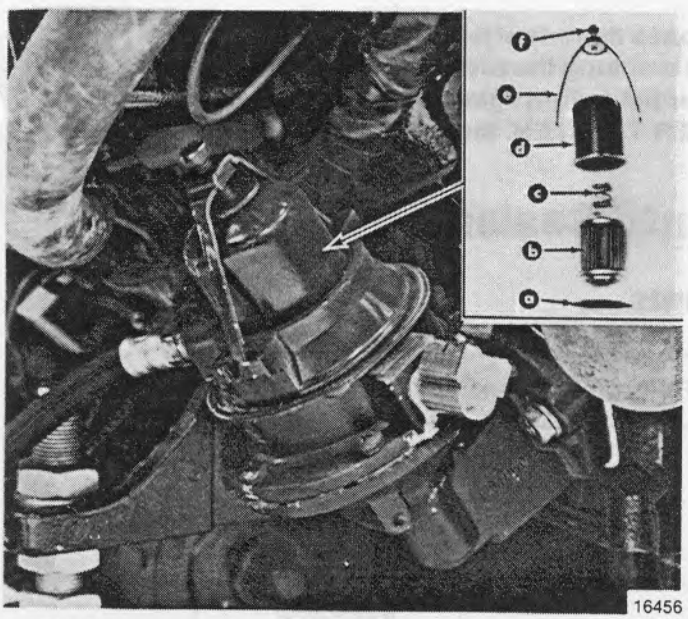
⚠WARNING

Be careful when changing fuel pump fuel filter; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF" DO NOT smoke or allow sources of spark or open flame in area when changing fuel filter. Wipe up any spilled fuel immediately.

Repair

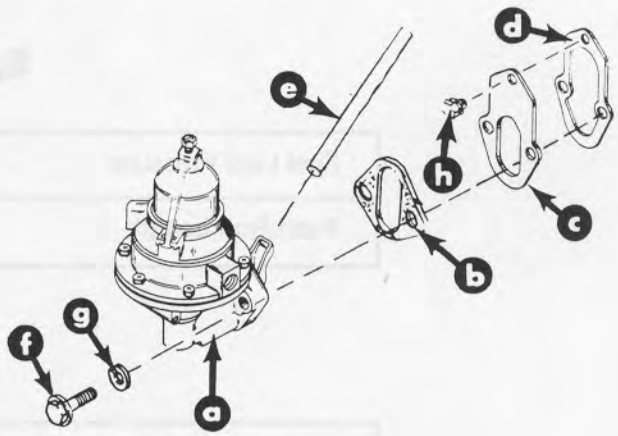
FILTER REPLACEMENT

1. Loosen screw above filter bowl and release bail from fuel pump housing.
2. Remove bowl, filter element, spring, and gasket.
3. Install:
   a. New gasket - On fuel pump.
   b. Filter element - Open end of filter element MUST BE down.
   c. Spring - On top of filter element.
   d. Bowl.
   e. Bail - Center over bowl and secure ends into slots on pump housing.
4. Tighten bail screw.
5. Start and run engine.
6. Check for gasoline leaks.
7. If leaks exist, STOP ENGINE and recheck connections. If leaks continue to exist, STOP ENGINE IMMEDIATELY and contact your Authorized MerCruiser Dealer.



a - Gasket
b - Filter Element
c - Spring
d - Bowl
e - Bail
f - Bail Screw

REMOVAL



a - Fuel Pump
b - Fuel Pump Gasket
c - Plate
d - Plate Gasket
e - Push Rod
f - Bolt
g - Lock Washer
h - Bolt

1. Disconnect fuel lines at pump and cap lines.
2. Remove mounting bolts, pump and gasket.
3. Remove bolt, mounting plate and gasket.
4. Remove push rod.

CLEANING and INSPECTION

1. Clean with solvent, blow off with compressed air.
2. Inspect pump for cracks and distortion.
3. Inspect arm and push rod for excessive wear or loose hinge pin.

INSTALLATION

1. Install push rod, plate gasket, plate and bolt.
2. Install fuel pump gasket and fuel pump, and torque to specifications.
3. Connect fuel lines to pump, and torque to specifications.
4. Start engine and check for leaks.

Carter Fuel Pump

Specifications

Fuel Line Pressure	3-7 P.S.I.
Push Rod Length	5 in. (127mm)

Torque

FASTENER LOCATION	LB. FT. (N·m)
Inlet Fitting to Pump	Note 1
Outlet Fitting to Pump	Note 1
Pump to Block	20 (27)
Fuel Line Flare Nut to Inlet/Outlet Fitting	Securely

NOTE 1:

⚠CAUTION

Apply #592 Loctite Pipe Sealant with Teflon to threads of fuel inlet line connector. DO NOT USE TEFLON TAPE. To prevent cracking the casting and/or fuel leaks, turn inlet connector in by hand until finger tight, then tighten connector to 1-3/4 to 2-1/4 turns with wrench. DO NOT OVER TIGHTEN. Inspect for fuel leaks.

Tools/Lubricants/Sealants

Sealants

Loctite Pipe Sealant with Teflon — Obtain Locally

Special Tools

FUEL PRESSURE GAUGE	J29658-B
KENT-MOORE SPECIAL TOOLS Can be ordered from: Kent-Moore Tools, Inc. 29784 Little Mack Roseville, MI 48066 Phone: (313) 774-9500	

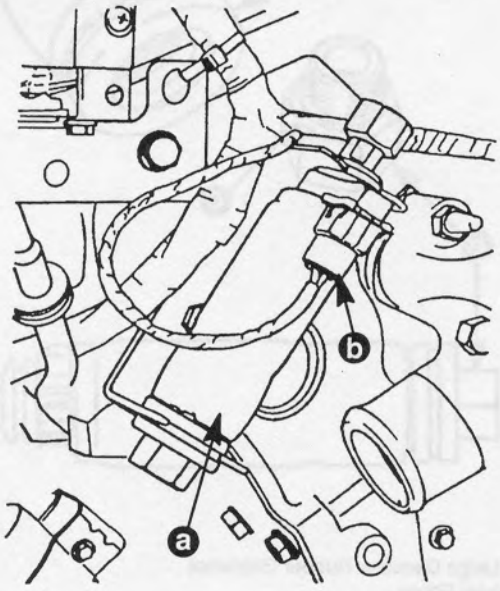
Electric Fuel Pump

NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

Replacement

IMPORTANT: The electric fuel pump cannot be repaired. If pump fails, it must be replaced.



71292

a - Fuel Pump
b - Wiring Harness

All Models

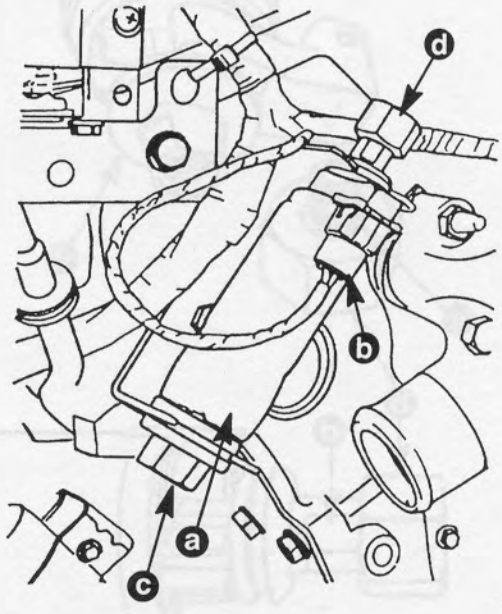
REMOVAL

1. Disconnect battery cables from battery.

⚠CAUTION

Plug fuel supply hose after removal to prevent fuel from leaking into boat.

2. Using wrench to stabilize fuel pump inlet and outlet couplings, loosen and remove upper and lower fuel line connectors. Carefully move fuel lines enough to clear pump.



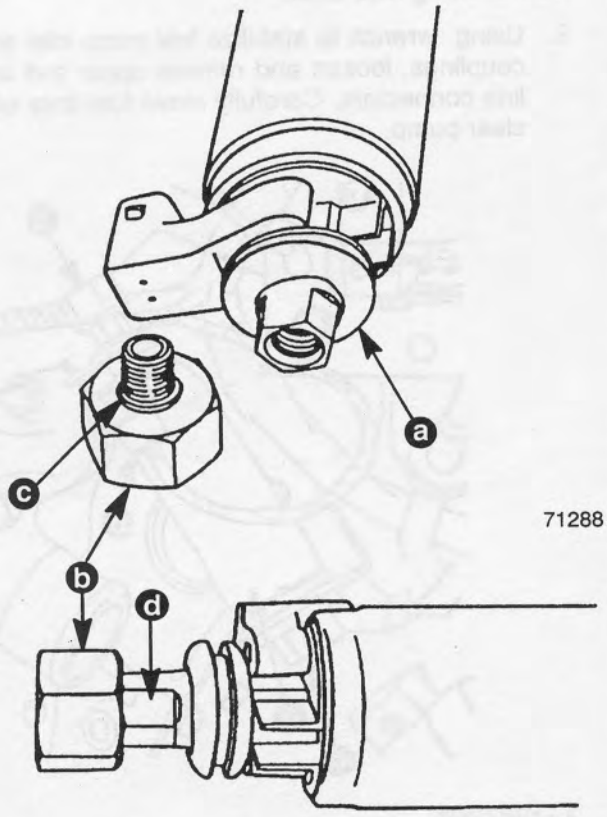
71292

a - Fuel Pump
b - Wiring Harness
c - Inlet Coupling (Large)
d - Outlet Coupling (Small)

3. Unplug wiring harness at fuel pump connection.
4. Remove fuel pump by pulling out of bracket.

INSTALLATION

1. Install small diameter rubber grommet on outlet side of fuel pump. Install O-ring on outlet fitting and install fitting on pump. Use the flat surface on pump outlet to hold pump while tightening. Torque to 84 lb. in. (9.5 N•m).

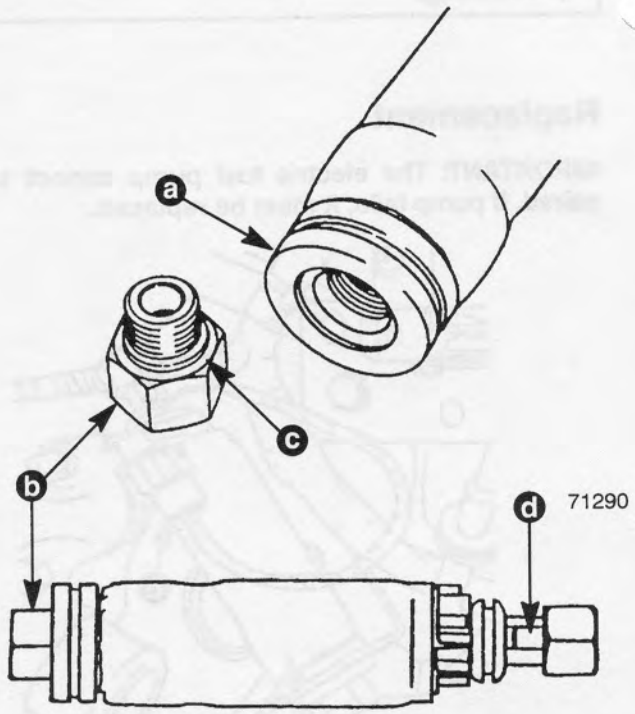


71288

71289

a - Small Diameter Rubber Grommet
b - Outlet Fitting
c - O-Ring
d - Flat (Hold with Wrench)

2. Install large diameter rubber grommet on inlet side of fuel pump. Install O-ring on inlet fitting and install fitting on pump. Use the flat surface on pump outlet to hold pump while tightening. Torque fitting to 96 lb. in. (10.8 N•m).

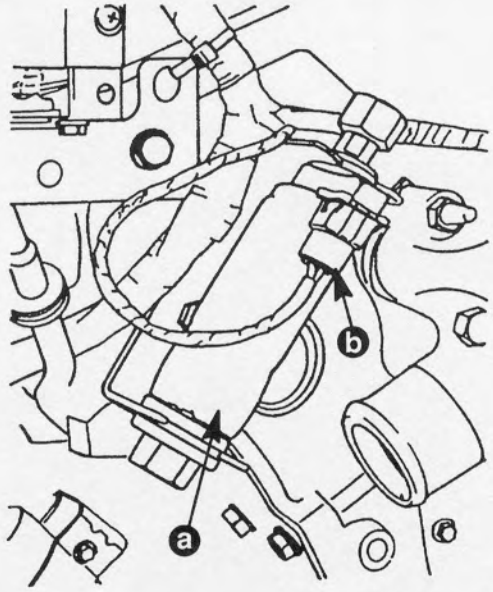


71290

71291

a - Large Diameter Rubber Grommet
b - Inlet Fitting
c - O-Ring
d - Flat (Hold with Wrench)

3. Install fuel pump in bracket and connect wiring harness.



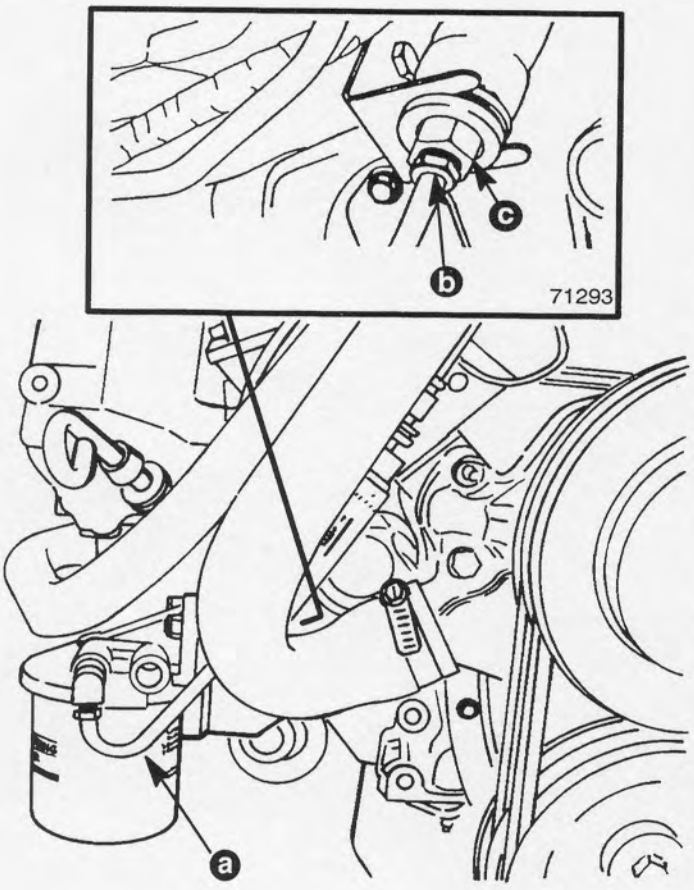
71292

a - Fuel Pump
b - Wiring Harness

⚠CAUTION

Avoid damage to electric fuel pump. Securely hold lower and upper fuel pump fittings with suitable wrench when tightening fuel line fittings.

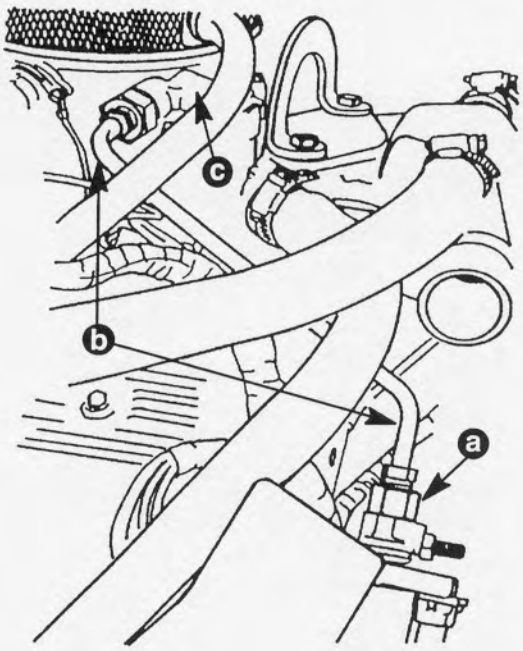
4. Connect lower fuel line at pump. Hold fuel pump fitting with a suitable wrench and securely tighten fuel line fitting.



71880

a - Lower Fuel Line
b - Lower Fuel Line Connection at Pump
c - Fuel Pump Inlet Brass Coupling (Large)

5. Connect upper fuel line at fuel pump outlet. Hold fuel pump brass coupling with a suitable wrench and securely tighten fuel line fitting. Check that connections at fuel filter outlet coupling and at carburetor inlet coupling are tightened securely.

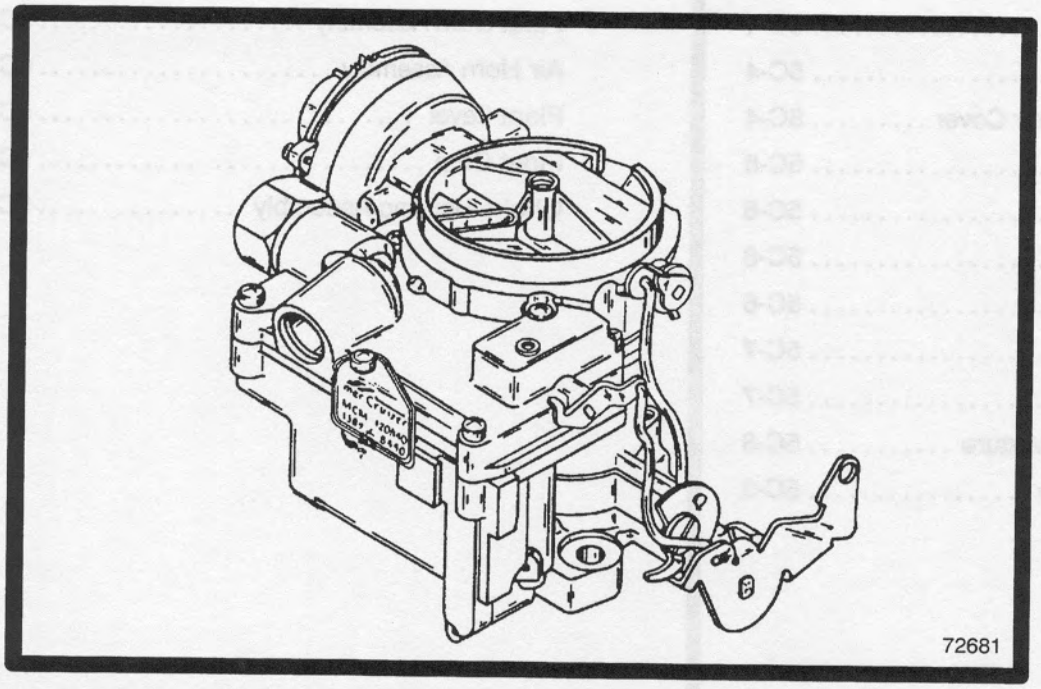


71294

a - Upper Fuel Line
b - Fuel Pump Outlet (Brass Connector)
c - Carburetor

6. Reconnect battery cables to battery.
7. Inspect all fuel system lines and fittings for leaks when first starting engine.

FUEL SYSTEM



2 BARREL CARBURETOR

5

C

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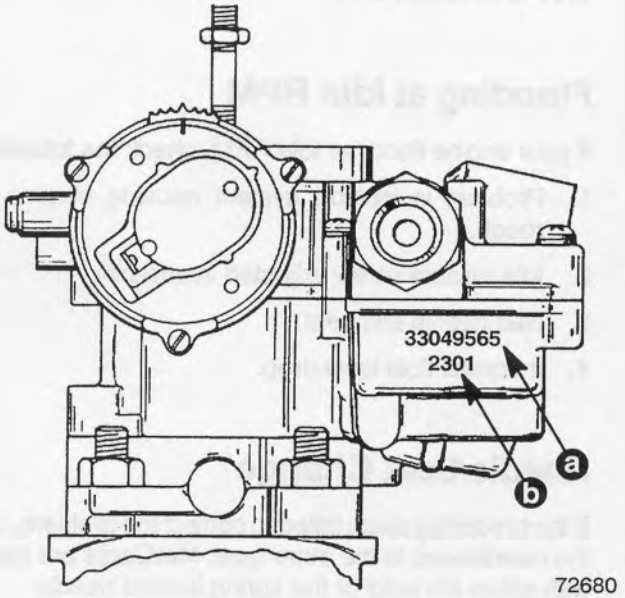
Identification



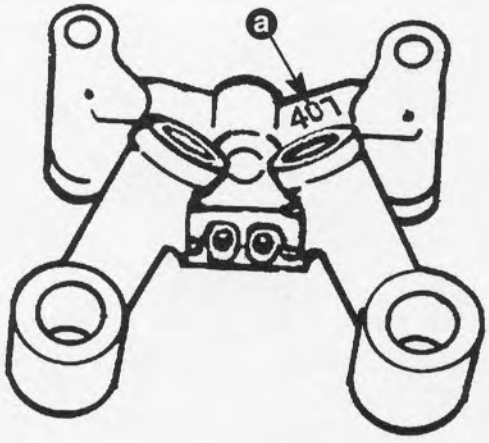
72680

a - Part Number
b - Date Code

Carburetor Part Number Location

Data Code Explanation: Example 2301

First Figure is Year:
2 = 1992, 3 = 1993, etc.
Second Figure is Month:
2 = February, 3 = March, etc.
X = October, Y = November, Z = December
Third and Fourth Figures are Day of Month:
01 = First day, 02 = Second day, etc.



72779

a - Identification Number (See Specifications)

Venturi Cluster Identification

Replacement Parts Warning

⚠WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Torque Specifications

Fastener Location	lb. ft.	N·m
Carburetor to Manifold	12	16
Fuel Line to Carburetor	18	24
Fuel Inlet Filter Nut	18	24

Tools

Part Number	Description
79-17391A1	Tachometer
91-36392	Universal Carburetor Gauge

Borroughs Special Tools

Can be ordered from: Borroughs Tool & Equip. Corp.
2429 N. Burdick Street
Kalamazoo, MI 49007
Phone: (616) 345-5163

Part Number	Description
BT-8128 B	Float Gram Scale

Specifications

UNIT OF MEASUREMENT In. (mm)

CARBURETOR ADJUSTMENT SPECIFICATIONS

All measurements are ± 1/64 in. (0.4 mm).

Engine Model	MCM 185/4.3L
Part Number	3310-806080 3304-9353, 3304-9565
Float Level : 2 Piece Solid Inlet Needle	3/8 (10)
Sproing Loaded Inlet Needle	9/16 (14)
Float Drop (Note1)	1-1/4 (32 mm)
Pump Rod	1-5/32 (29)
Choke Setting	One Mark Right Of Index Marks
Choke Unloader	.080 [5/64] (0.2)
Idle Mixture Screw Preliminary Setting	1-1/4 Turns
Float Weight	9 Grams Max.
Primary Jet Size	.072 (1.85)
Venturi Cluster ID Number	421
Power Valve Size	0.75 mm

Note 1:Measured from air horn (with gasket in place) to toe of float.

Note 2:To correct surge or popping condition above 4000 RPM install 1.60 mm main jets.

Important Service Information

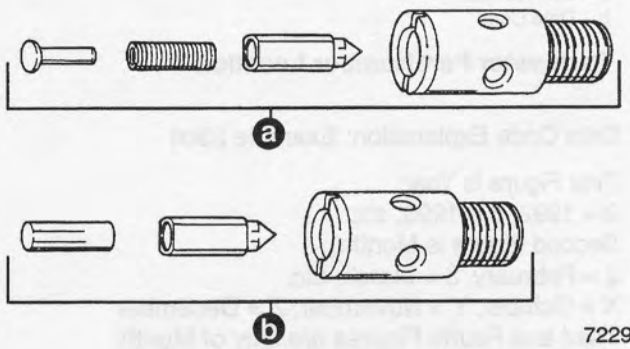
Flooding at Idle RPM

If your engine floods at idle RPM, check the following:

1. Problem in ignition system causing engine to run rough.
2. Idle mixture screw adjusted incorrectly.
3. Bad needle and seat.
4. Incorrect float level drop.

Needle/Seat Change

If the preceding steps failed to correct the problem, change the needle/seat to the other type. MerCarbs are equipped with either the solid or the spring loaded needle.

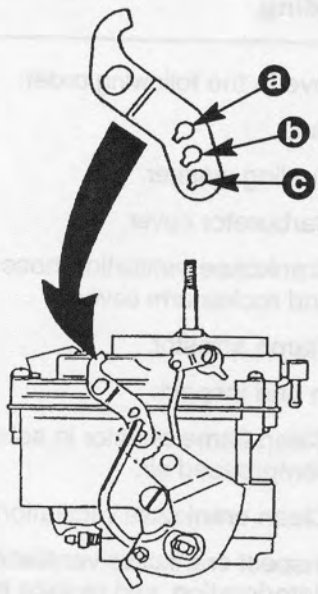


a - Spring Loaded Type Needle (Kit P/N 3302-9029)
b - Solid Type Needle (Kit P/N 3302-9407)

Needle and Seat Assemblies

Adjustable Accelerator Pump Lever

This new 3-holed lever will allow you to change the amount of fuel delivered to the engine by the accelerator pump. The hole closest to the lever's shaft will give the same amount of fuel as the single hole lever did. The center hole gives approximately 0.5 cc less fuel and the hole farthest away will give about 1.0 cc less fuel.



73131

a - Full Accelerator Pump Stroke
b - 0.5 cc Less Fuel per Stroke
c - 1.0 cc Less Fuel per Stroke

The technician should be able to correct most "bogging" problems with this 3-holed lever, providing the "bogging" is caused by the carburetor. When installing the 3-holed lever, remove any metal ball that someone may have put in the accelerator pump well to limit pump travel. Also, make sure that the duration spring on the accelerator pump is stock and hasn't had several coils cut off. Make sure the venturi cluster is the correct one as outlined previously under "Specifications."

High Altitude Re-Jetting

Engine flooding problems, at idle RPM, are generally related to the altitude (above sea level) at which they are operated.

If engine is running too rich at higher elevation, order a smaller jet from the chart. A jet stamped "165" is a 1.65 mm jet.

Jet Size (mm)	Quicksilver Part Number
1.35	3302-11850
1.40	3302-811851
1.45	3302-9050
1.50	3302-811852
1.55	3302-811853
1.60	3302-810923
1.65	3302-9058

Description

This MerCarb carburetor is a two bore carburetor and has a separate fuel feed for each venturi. This model also is equipped with an electric choke. A removable venturi cluster (secured to float bowl assembly) has the calibrated main well tubes and pump jets built into it. The venturi cluster is serviced as a unit. The serviceable main metering jets are bleeds to properly meter the correct fuel/air mixture to the engine.

Precautions

⚠ WARNING

Always disconnect battery cables from battery BEFORE working on fuel system to prevent fire or explosion.

⚠ WARNING

Be careful when cleaning flame arrestor and crankcase ventilation hose; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is OFF. DO NOT smoke or allow sources of spark or open flame in area when cleaning flame arrestor and crankcase ventilation hose.

⚠ WARNING

Be careful when changing fuel system components; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is OFF. DO NOT smoke or allow sources of spark or flame in the area while changing fuel filter. Wipe up any spilled fuel immediately.

⚠ WARNING

Make sure no fuel leaks exist, before closing engine hatch.

Fuel Supply Connections

⚠ CAUTION

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

Maintenance

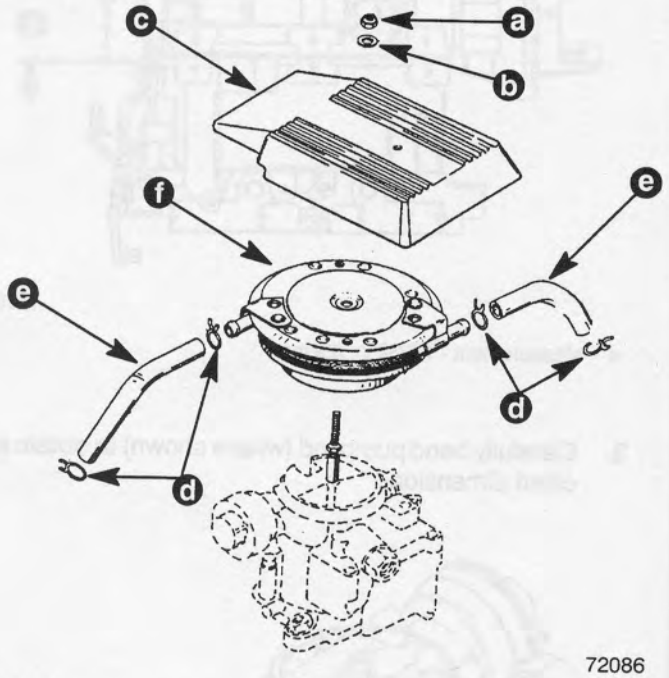
Flame Arrestor with Carburetor Cover

NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

1. Remove in the following order:
   a. Nut.
   b. Sealing washer.
   c. Carburetor cover.
   d. Crankcase ventilation hoses from flame arrestor and rocker arm covers.
   e. Flame arrestor.
2. Clean and inspect:
   a. Clean flame arrestor in solvent and blow dry with compressed air.
   b. Clean crankcase ventilation hoses.
   c. Inspect crankcase ventilation hoses for cracks or deterioration, and replace if necessary.

3. Install in the following order:
   a. Flame arrestor.
   b. Crankcase ventilation hoses to flame arrestor and rocker arm covers.
   c. Carburetor cover.
   d. Sealing washer.
   e. Nut (tighten securely).



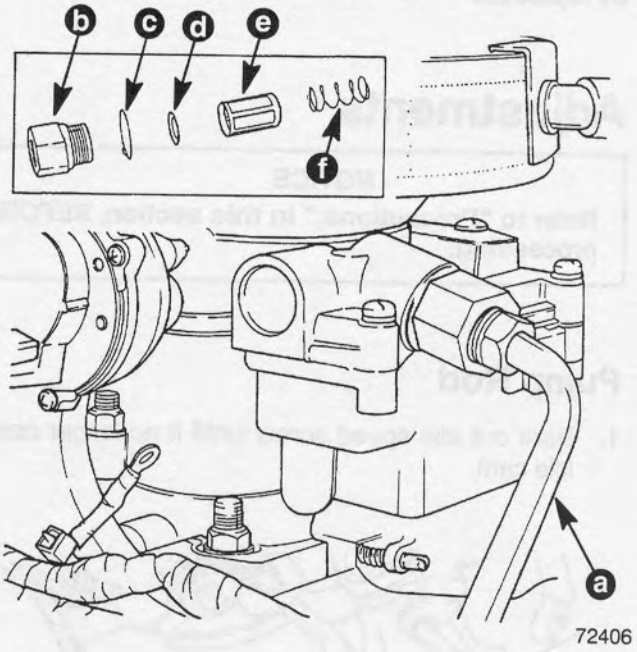
72086

a - Nut
b - Sealing Washer
c - Carburetor Cover
d - Cable Tie
e - Crankcase Ventilation Hose
f - Flame Arrestor

Fuel Inlet Filter

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

1. Remove in the following order:
   a. Fuel line from fuel inlet filter nut.
   b. Fuel inlet filter nut and small gasket.
   c. Large gasket.
   d. Filter.
   e. Spring.
   f. Small gasket - from inside filter nut.



72406

a - Fuel Line
b - Fuel Inlet Filter Nut
c - Gasket (Large)
d - Gasket (Small)
e - Filter
f - Spring

2. Clean filter nut and spring in solvent and dry with compressed air.
3. Install in the following order:
   a. Spring - place in carburetor body.
   b. Filter - open end to inlet filter nut.
   c. Small gasket - place inside filter nut.
   d. Large gasket - place over filter nut threads.
   e. Fuel inlet filter nut - torque nut to 18 lb. ft. (24 N•m).
   f. Fuel line - torque to 18 lb. ft. (24 N•m).

Choke Inspection

The choke does not require any periodic maintenance; however, if a choke malfunction is suspected, the following should be done:

1. With engine turned OFF, remove flame arrestor.
2. Open and close choke several times, and check for binding, loose or disconnected linkages, or other signs of damage.
3. If choke or linkage binds, sticks, or works sluggishly, clean with carburetor choke cleaner. Follow directions on can.

IMPORTANT: Choke valve and shaft and lever assembly is not serviceable. If valve and/or shaft and lever assembly is worn or damaged, air horn assembly must be replaced.

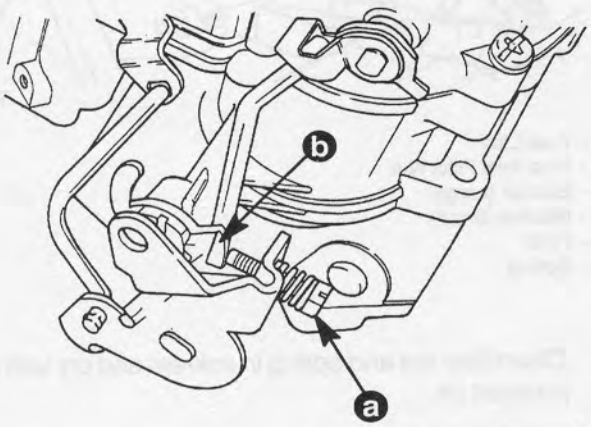
Adjustments

NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

Pump Rod

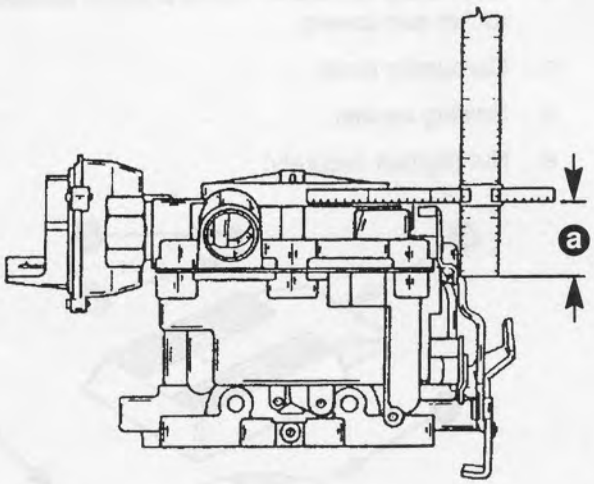
1. Back out idle speed screw until it no longer contacts idle cam.



72284

a - Idle Speed Screw
b - Idle Cam

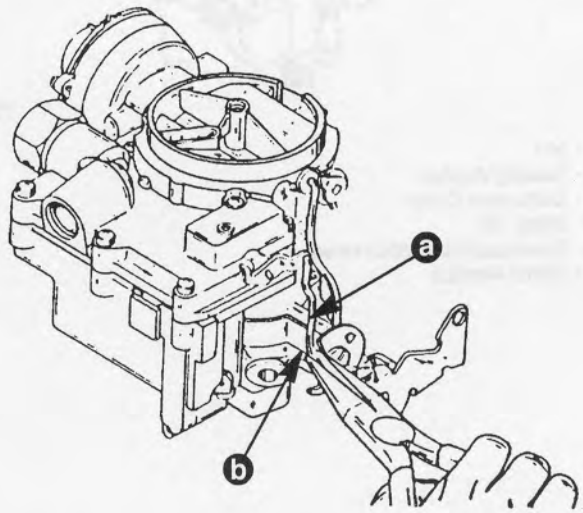
2. With throttle valves completely closed, measure from flame arrestor mounting surface to top of pump rod.



72682

a - Measurement - 1-5/32 in. (29 mm)

3. Carefully bend pump rod (where shown) to obtain specified dimension.

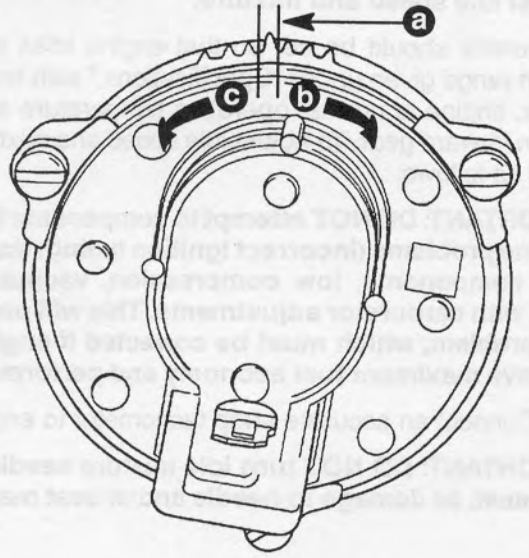


72683

a - Pump Rod
b - Bend Here

Choke Setting

Normal choke setting is such that scribed mark on cover is in line with long case mark on choke housing.



72403

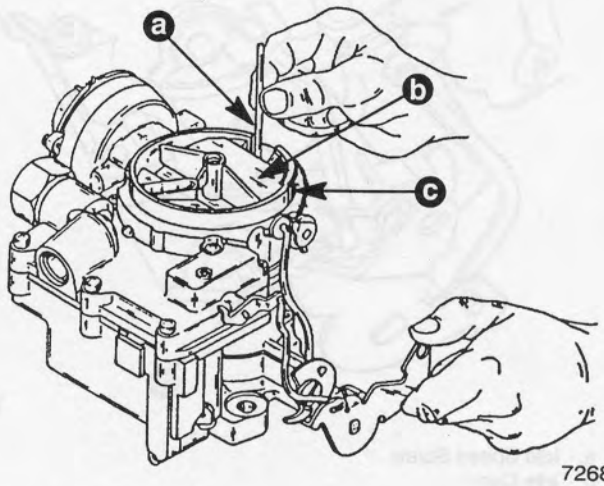
a - Scribed Mark
b - More Choke
c - Less Choke

If choke adjustment is necessary:

1. Loosen three choke cover retaining screws and adjust as shown.
2. Tighten three choke cover retaining screws securely.

Choke Unloader

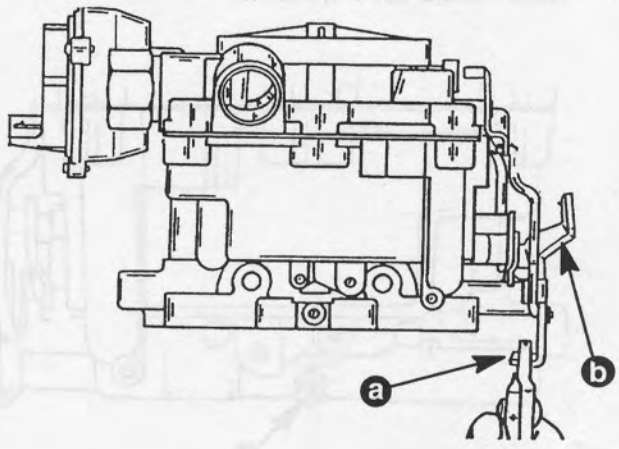
1. Hold throttle valves completely open.
2. Gently press down on choke plate.
3. Using an .080 in. [5/64 in.] (0.2 mm) drill rod, or appropriate gauge, slide rod between upper edge of choke plate and air horn assembly. Rod should just slide through.



72684

a - .080 In. (0.2 mm) Drill Rod
b - Choke Plate
c - Air Horn

4. Bend tang on throttle lever, if necessary, to obtain specified dimension.



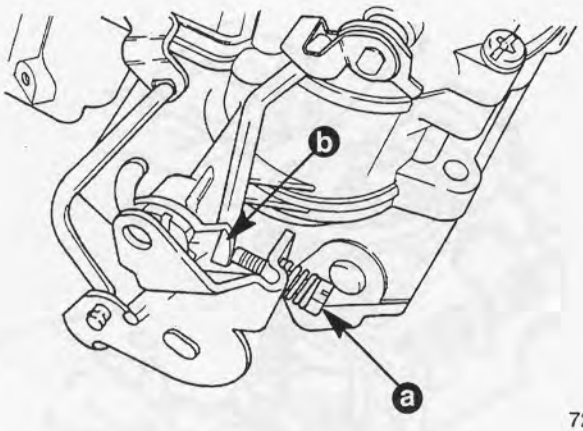
72685

a - Tang
b - Throttle Level

Preliminary Idle Speed and Mixture

IMPORTANT: The following adjustments will provide a sufficient idle speed and mixture for starting engine. Final adjustments must be made with engine running.

1. Back out idle speed screw until it no longer contacts idle cam. Turn idle speed screw in until it just contacts idle cam, then turn screw in an additional two turns.

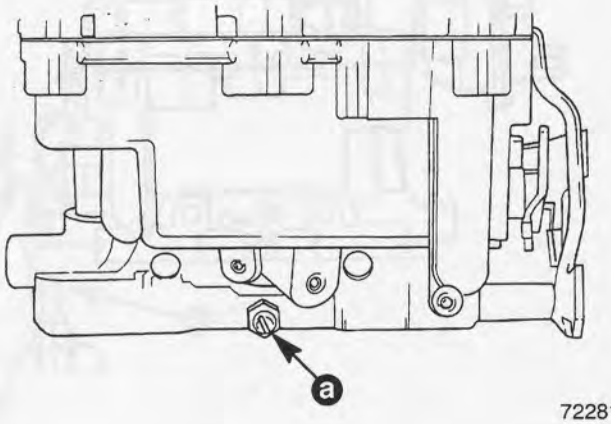


72284

a - Idle Speed Screw
b - Idle Cam

IMPORTANT: DO NOT turn idle mixture needle tightly against seat (in the following step), as damage to seat and/or needle may result.

2. Turn idle mixture needle in until lightly seated, then back needle out 1-1/4 turns.



72281

a - Idle Mixture Needle

Final Idle Speed and Mixture

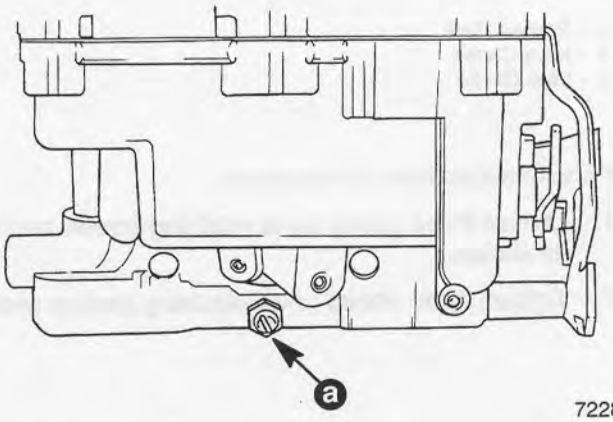
IMPORTANT: Boat must be in the water and engine at normal operating temperature to accurately check and adjust idle speed and mixture.

Carburetor should be set so that engine idles smooth within range given under "Specifications," with boat in the water, engine at normal operating temperature and drive unit in forward gear. To adjust idle speed and mixture, proceed as follows:

IMPORTANT: DO NOT attempt to compensate for other engine problems (incorrect ignition timing, faulty ignition components, low compression, vacuum leaks, etc.) with carburetor adjustments. This will only cover the problem, which must be corrected if engine is to achieve maximum fuel economy and performance.

1. Connect an accurate shop tachometer to engine.

IMPORTANT: DO NOT turn idle mixture needle tightly into seat, as damage to needle and/or seat may result.



72281

a - Idle Mixture Needle

2. If new or rebuilt carburetor has been installed, turn idle mixture needle in (clockwise) until it lightly contacts seat, then back out needle 1-1/4 turns. This will provide a sufficient setting to allow starting engine.
3. Start engine and run at 1500 RPM until engine reaches normal operating temperature.

⚠ WARNING

DO NOT leave the helm unattended while performing idle speed and mixture adjustments, following. BE CAREFUL NOT TO ACCIDENTALLY ACCELERATE ENGINE WHILE PERFORMING ADJUSTMENTS.

4. With boat in open water, place remote control in forward gear, idle position.
5. Disconnect throttle cable barrel from anchor stud. Be sure not to lose spacer on anchor stud.
6. Adjust idle speed adjustment screw to obtain 550-6[illegible] RPM, in neutral gear.

7. With engine running at specified RPM, adjust idle mixture needle as follows:
   a. Turn idle mixture needle in (clockwise) until the engine speed begins to drop due to lean mixture.
   b. Turn idle mixture screw out (counterclockwise) until the speed begins to drop due to rich mixture.
   c. Turn screw in to a point between these two extremes to obtain maximum engine smoothness and RPM.
   d. Readjust idle speed adjustment screw until engine idles at 650-700 RPM in forward gear.

IMPORTANT: Refer to Section 2 - "Removal and Installation" for throttle cable installation and adjustment.

Repair

NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

Removal

IMPORTANT: Carburetor malfunctions are, in many cases, caused by the presence of dirt, water or other foreign matter in carburetor. To aid in diagnosis, carefully remove carburetor from engine without draining fuel from bowl. Contents of fuel bowl may then be inspected for contamination as carburetor is disassembled.

1. Remove ventilation hose from flame arrestor, then remove flame arrestor.

IMPORTANT: Place a clean cloth in bores of carburetor to prevent dirt and foreign material from falling into bores.

2. Turn fuel supply off at fuel tank.
3. Disconnect throttle cable from carburetor.
4. Remove fuel line from fuel inlet nut, using wrench to stabilize fuel inlet nut.
5. Remove fuel pump sight tube from carburetor.
6. Disconnect electric choke.
7. Remove carburetor attaching nuts and washers and remove carburetor.

IMPORTANT: Place a clean cloth over intake manifold opening to prevent dirt or foreign material from entering manifold.

8. Remove and discard gaskets.

Installation

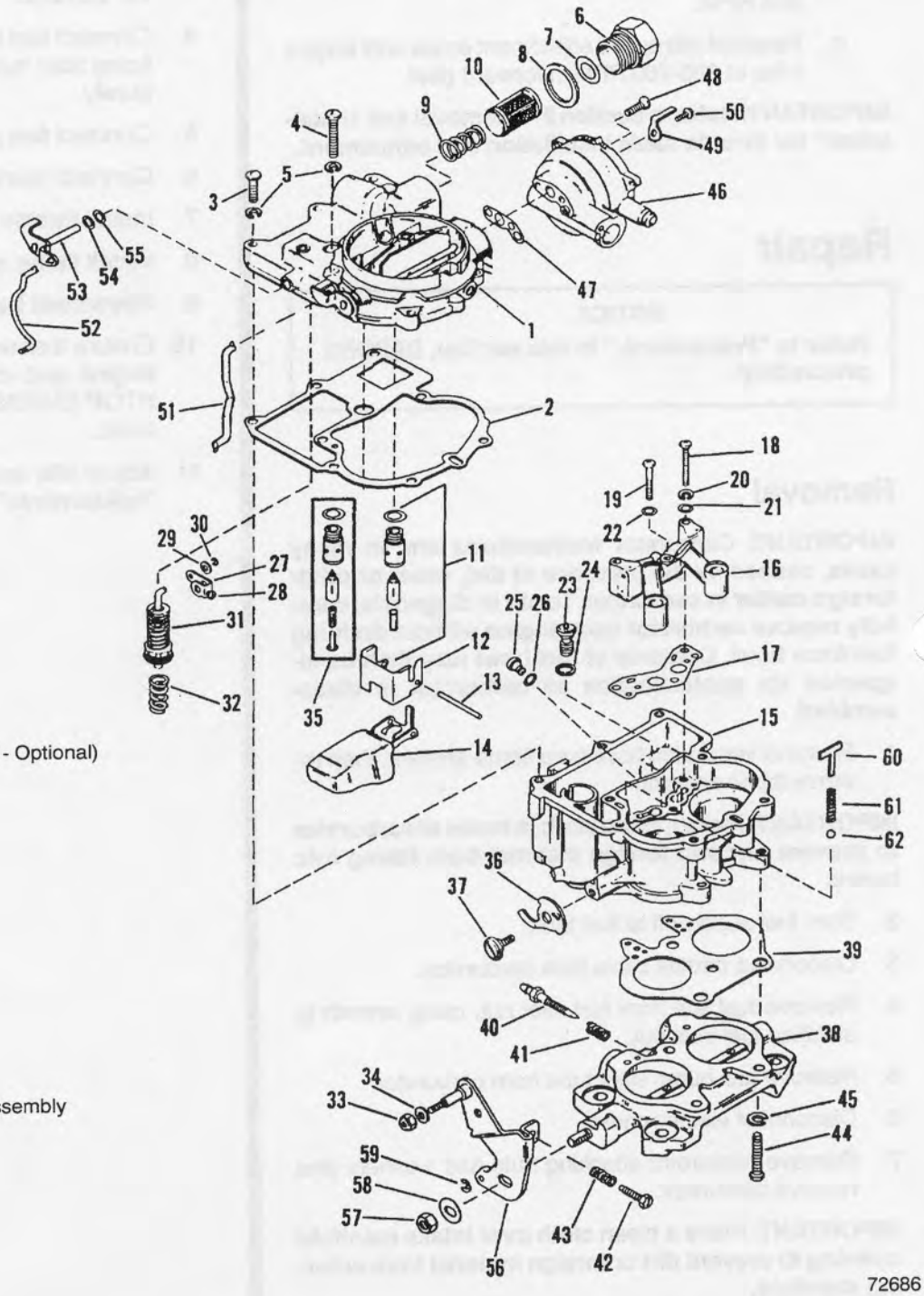
1. Thoroughly clean gasket surfaces.
2. Place new carburetor base gasket on intake manifold. Install carburetor and secure with nuts and washers. Torque to 132 lb. in. (15 N•m).
3. If fuel inlet filter nut was disturbed, remove; clean all threads with brush and carburetor cleaner or Quicksilver Leveler.
4. Connect fuel line to fuel inlet filter nut, and while stabilizing filter nut with wrench, tighten fuel line fitting securely.
5. Connect fuel pump sight tube to fitting on carburetor.
6. Connect electric choke wires to choke cover.
7. Install throttle cable as explained in Section 2.
8. Install flame arrestor and crankcase ventilation hose.
9. Reconnect battery cables to battery.
10. Ensure that water is supplied to cooling system. Start engine and check for gasoline leaks. If leaks exist, STOP ENGINE IMMEDIATELY and recheck connections.
11. Adjust idle speed and idle mixture, as outlined under "Adjustments" as previously outlined.

Disassembly

The following is a step-by-step procedure for completely overhauling carburetor removed from engine. In many cases, however, complete overhaul is not necessary and, in these cases, only the steps required to repair the carburetor malfunction should be performed. Read the instructions carefully to prevent doing any unnecessary steps.

IMPORTANT: Before performing any service on carburetor, it is essential that carburetor be placed in a holding fixture to prevent possible damage to throttle valves.

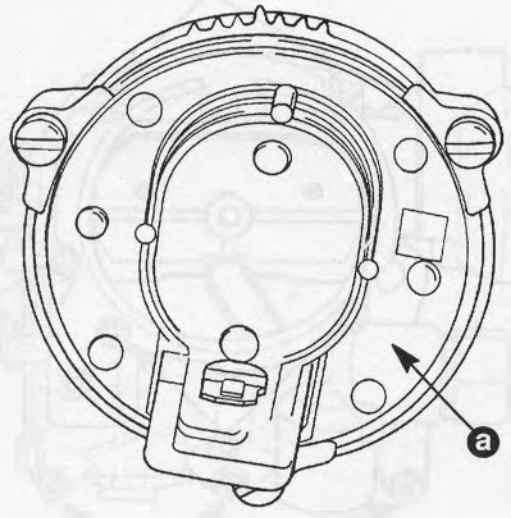
1 - Air Horn
2 - Gasket
3 - Screw
4 - Screw
5 - Lockwasher
6 - Nut - Fuel Inlet
7 - Gasket
8 - Gasket
9 - Spring
10 - Filter
11 - Inlet Needle and Seat (Solid)
12 - Baffle Plate
13 - Pin
14 - Float
15 - Float Bowl
16 - Venturi Cluster
17 - Gasket
18 - Screw
19 - Screw
20 - Lockwasher
21 - Flat Washer
22 - Gasket
23 - Power Valve Assembly
24 - Gasket
25 - Jet
26 - Gasket
27 - Pump Shaft and Lever Assembly
28 - Screw
29 - Washer
30 - Clip - Retainer
31 - Accelerator Pump Assembly
32 - Spring
33 - Nut
34 - Spring Washer
35 - Inlet Needle and Seat (Spring Loaded - Optional)
36 - Cam - Idle
37 - Screw
38 - Throttle Body
39 - Gasket
40 - Idle Mixture Adjusting Needle
41 - Spring
42 - Screw - Idle Speed Adjustment
43 - Spring
44 - Screw
45 - Lockwasher
46 - Choke/Housing
47 - Gasket
48 - Screw
49 - Lever Assembly
50 - Screw
51 - Rod - Choke
52 - Rod - Accelerator Pump
53 - Accelerator Pump Shaft and Lever Assembly
54 - Washer (Outer)
55 - Washer (Inner)
56 - Throttle Lever
57 - Nut
58 - Washer - Locking
59 - Clip - Pump Rod
60 - Retainer
61 - Spring
62 - Check Ball



72686

CHOKE HOUSING ASSEMBLY

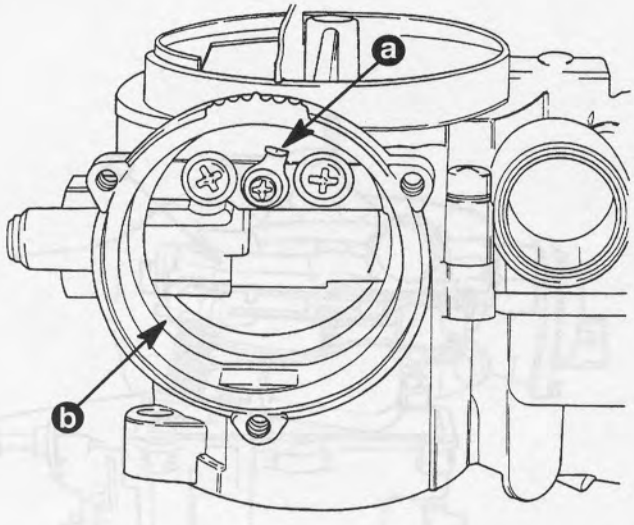
1. Remove choke cover.



72403

a - Choke Cover

2. Remove choke lever. Remove choke housing.



72401

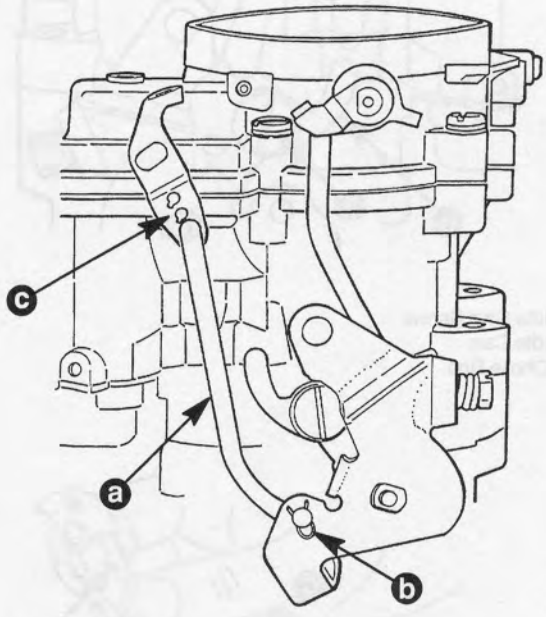
a - Choke Lever
b - Choke Housing

AIR HORN ASSEMBLY

1. Remove fuel inlet filter nut, washers, spring, and filter, as outlined previously.

IMPORTANT: Before performing the following step, make a note of the "hole location" of the pump rod in the pump shaft and lever assembly. Also, see "Adjustable Accelerator Pump Lever" information listed previously in this section.

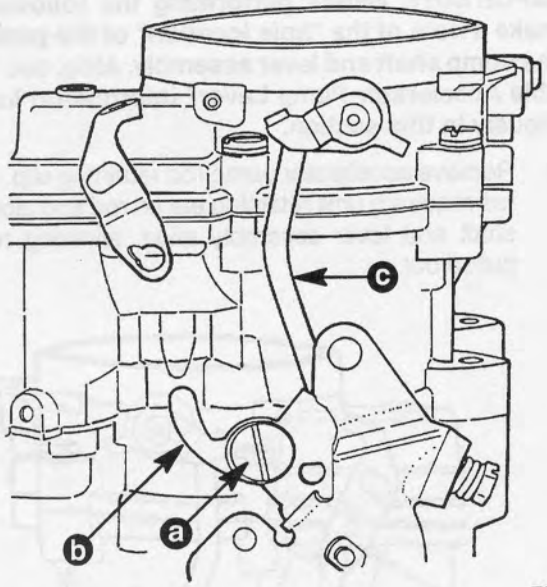
2. Remove accelerator pump rod retaining clip. Pivot rod (as required) until retaining ear on rod and slot in pump shaft and lever assembly align, allowing rod to be pulled out.



72283

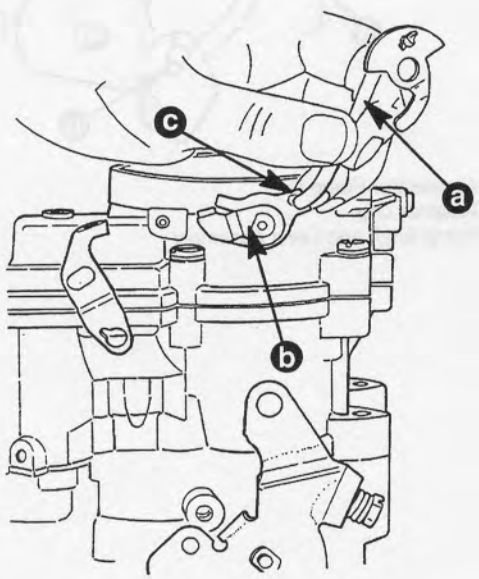
a - Accelerator Pump Rod
b - Retainer Clip
c - Pump Shaft and Lever Assembly

3. Remove idle cam screw. Also, remove choke rod by pivoting rod (as required) until retaining ear on rod and slot in choke lever align, allowing rod to be pulled out.



72282

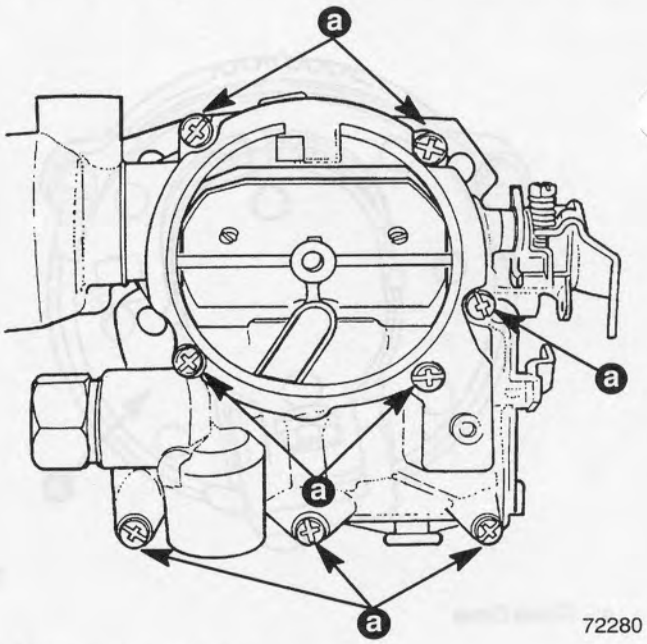
a - Idle Cam Screw
b - Idle Cam
c - Choke Rod



72286

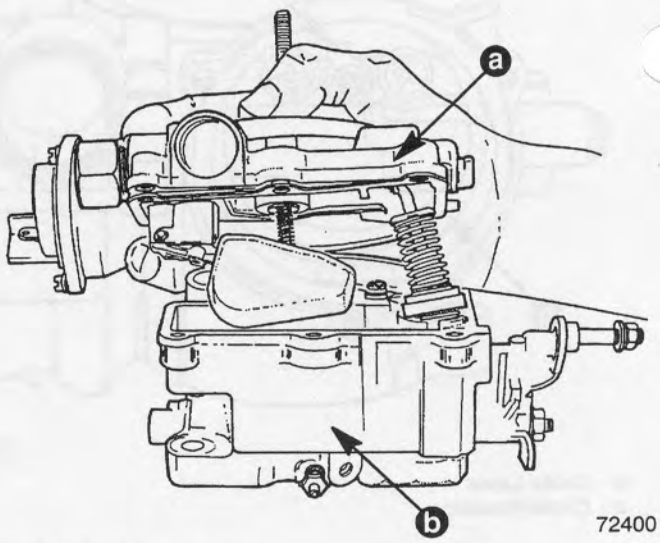
a - Choke Rod
b - Choke Lever
c - Slot

4. Remove air horn attaching screws as shown. Carefully lift air horn from float bowl assembly.



72280

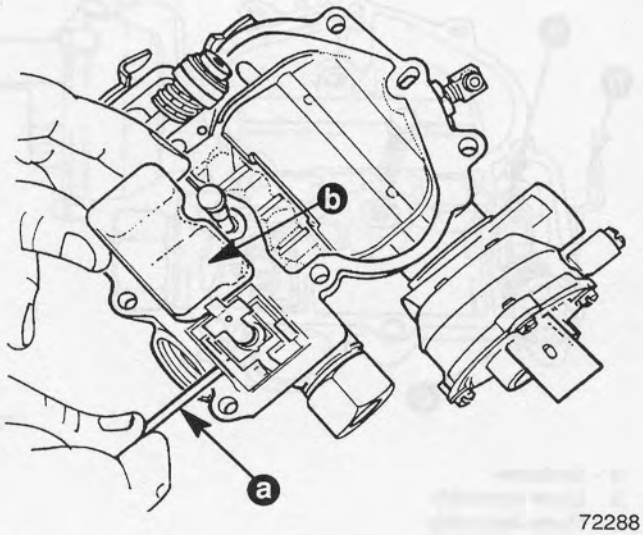
a - Air Horn Attaching Screws



72400

a - Air Horn Assembly
b - Float Bowl Assembly

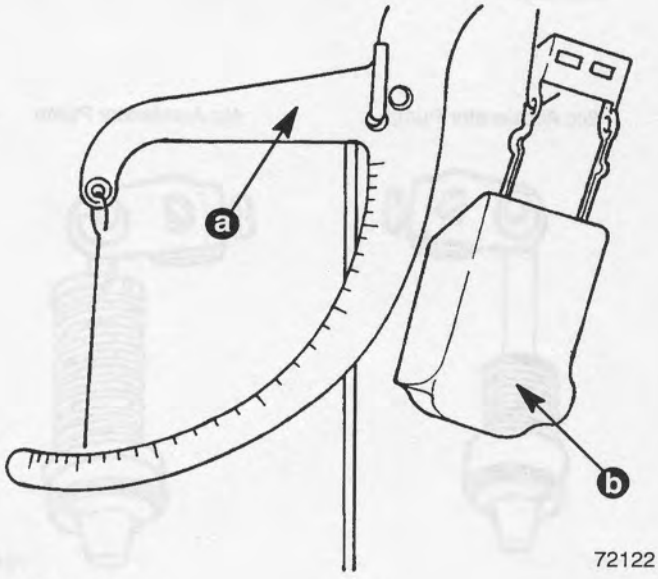
5. Invert air horn and carefully lay on bench.
6. Remove float hinge pin and lift float assembly from air horn.



72288

a - Float Hinge Pin
b - Float Assembly

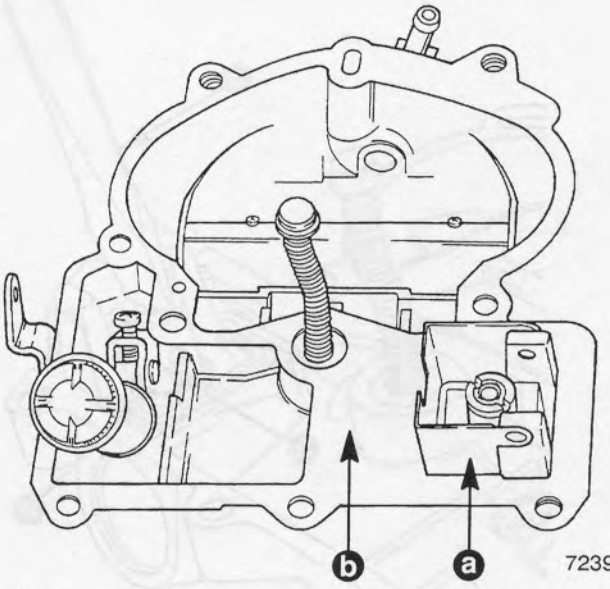
7. Check float weight as shown.



72122

a - Grams Scale
b - Float

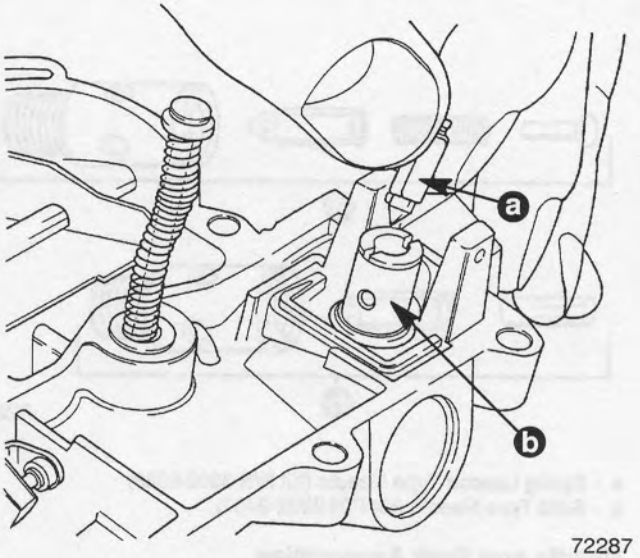
8. Remove air horn gasket and baffle.



72399

a - Baffle
b - Air Horn Gasket

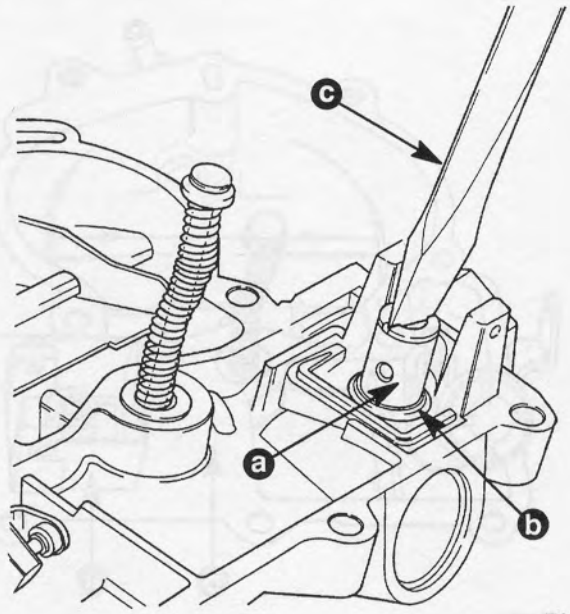
9. Remove needle assembly.



72287

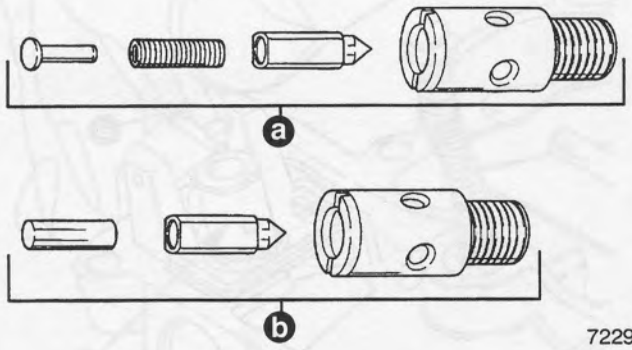
a - Needle Assembly
b - Needle Seat

10. Remove needle seat.



72289

a - Needle Seat
b - Gasket
c - Screwdriver

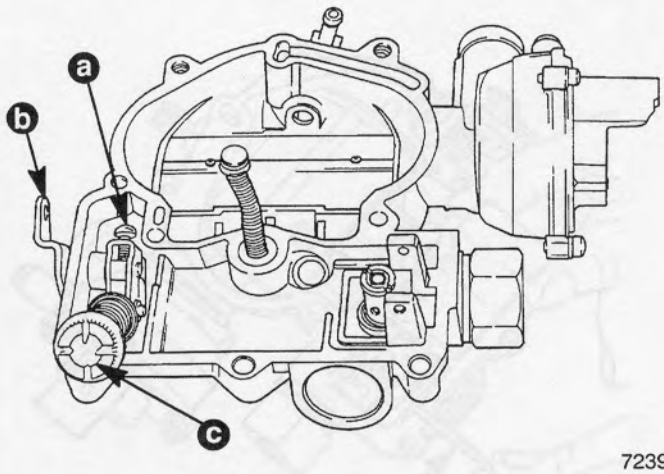


72290

a - Spring Loaded Type Needle (Kit P/N 3302-9029)
b - Solid Type Needle (Kit P/N 3302-9407)

Needle and Seat Assemblies

11. Loosen accelerator pump screw. Slide pump shaft and lever assembly (and washer) out of air horn, then remove accelerator pump assembly.



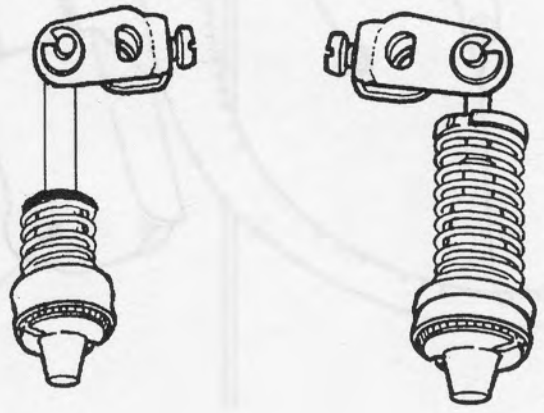
72398

a - Setscrew
b - Lever Assembly
c - Pump Assembly

12. Remove retainer clip and washer from pump shaft and lever assembly, then remove accelerator pump assembly.

2cc Accelerator Pump

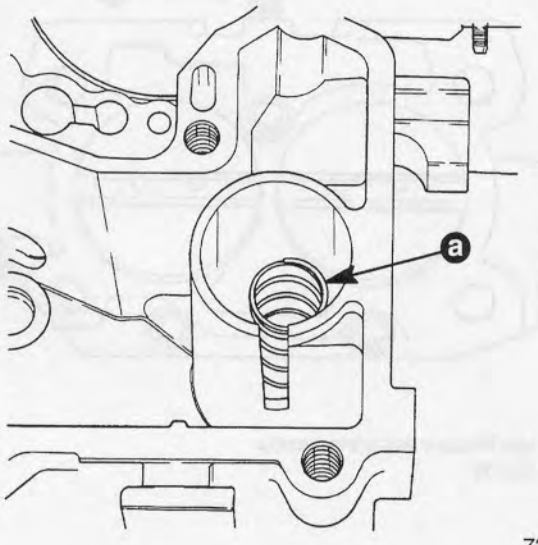
4cc Accelerator Pump



72409

FLOAT BOWL ASSEMBLY

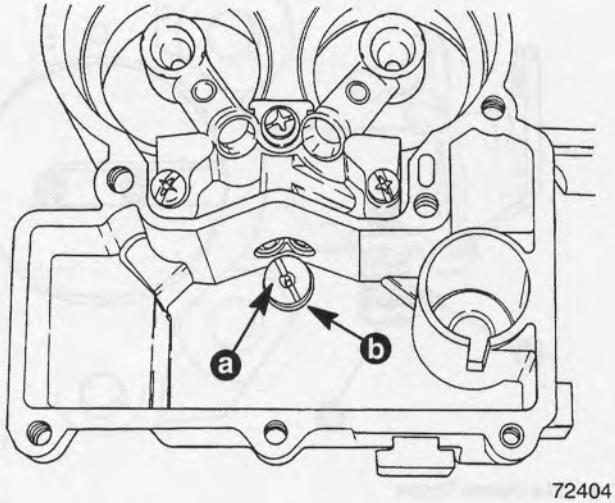
1. Remove accelerator pump return spring from pump well.



72402

a - Accelerator Pump Spring

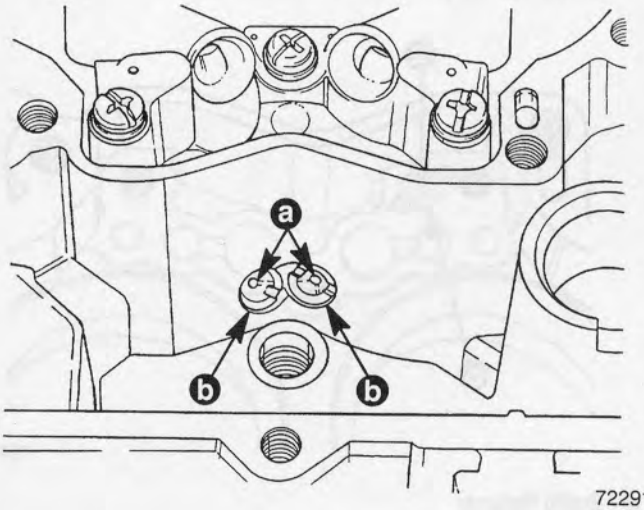
2. Remove power valve assembly and gasket.



72404

a - Power Valve Assembly
b - Gasket (Not Shown)

3. Remove main metering jets.

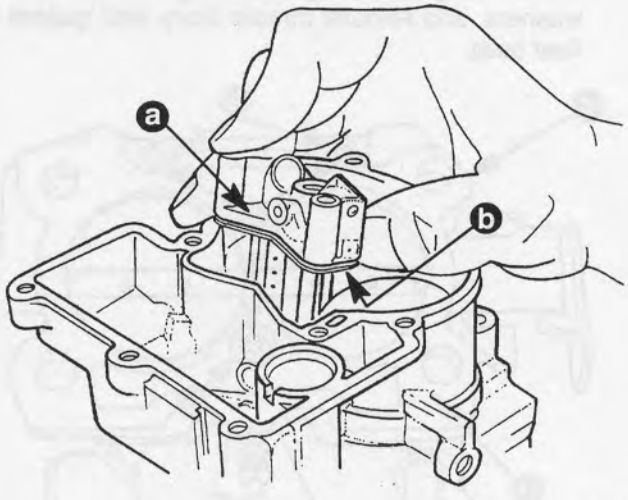


72291

a - Main Metering Jets
b - Gaskets (Not Shown)

IMPORTANT: Use care when removing venturi cluster to prevent damaging brass tubes which protrude from bottom of cluster. DO NOT REMOVE TUBES. These tubes are permanently pressed into the venturi cluster and are not replaceable.

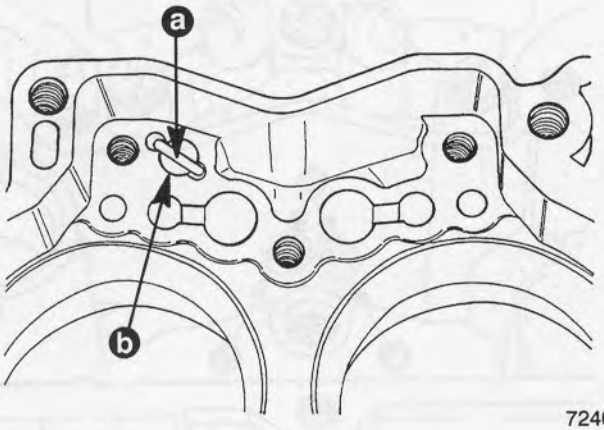
4. Remove three venturi cluster screws, and carefully lift cluster and venturi gasket straight up.



72292

a - Venturi Cluster Brass Tubes
b - Gasket

5. Using a needle-nose pliers, remove accelerator pump check ball spring retainer. Turn float bowl over to remove spring and check ball.



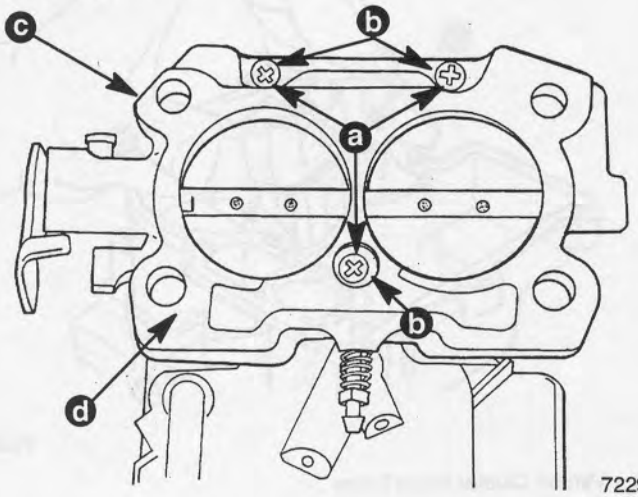
72407

a - Spring Retainer
b - Spring and Check Ball (Not Shown)

THROTTLE BODY ASSEMBLY

IMPORTANT: Use extreme care when handling throttle body, so as not to damage throttle valves.

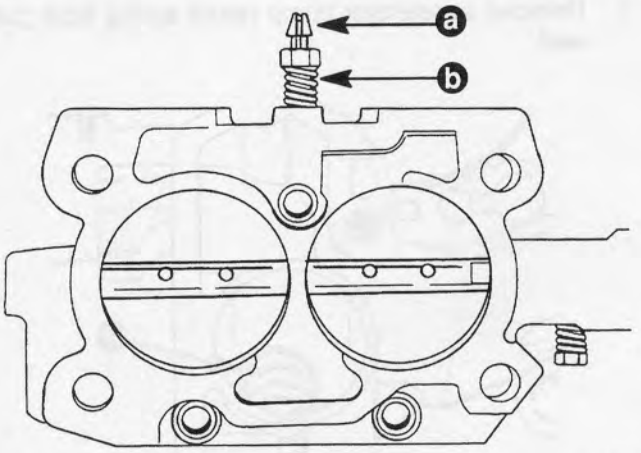
1. Place float bowl assembly upside down. Remove three throttle body assembly attaching screws and lockwashers, and remove throttle body and gasket from float bowl.



72294

a - Screws
b - Lockwashers (Not Shown)
c - Throttle Body
d - Gasket (Not Shown)

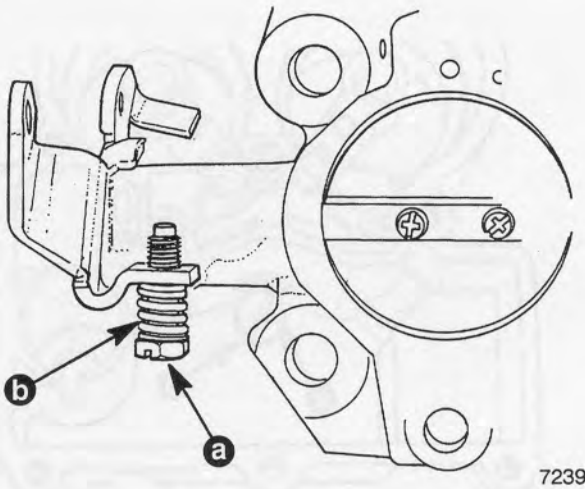
2. Remove idle mixture adjusting needle and spring.



72293

a - Idle Mixture Adjusting Needle
b - Spring

3. Remove idle speed adjustment screw and spring, if replacement is necessary.



72395

a - Idle Speed Screw
b - Spring

IMPORTANT: DO NOT remove throttle valves. If any of the throttle body parts are found to be worn or damaged, complete throttle body assembly MUST BE replaced. Throttle body assembly can be cleaned in carburetor cleaner.

Cleaning and Inspection

IMPORTANT: DO NOT use a wire or drill to clean jet passages or tubes in carburetor, as this may enlarge orifices and seriously affect carburetor calibration.

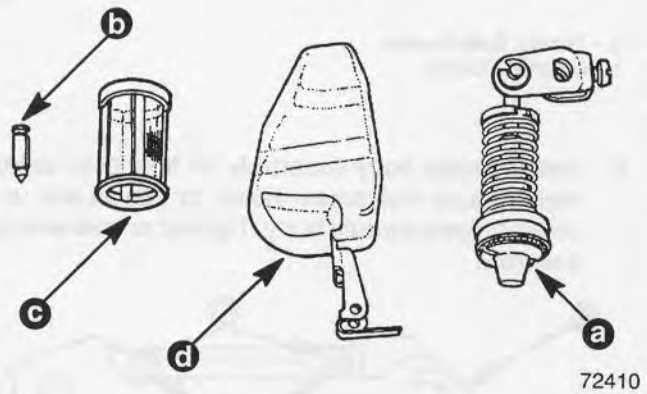
⚠CAUTION

To avoid damage to carburetor DO NOT leave carburetor in immersion type carburetor cleaner for more than two hours.

IMPORTANT: DO NOT clean float bowl gasket surfaces with a gasket scraper or knife, as sealing bead will be damaged and float bowl replacement will be necessary.

⚠CAUTION

The float assembly, float needle, accelerator pump plunger, and fuel filter MUST NOT BE immersed in carburetor cleaner, as they will swell, harden, and/or distort.



72410

a - Accelerator Pump Plunger
b - Float Needle
c - Fuel Filter
d - Float Assembly

⚠WARNING

Avoid personal injury by always wearing safety goggles when using compressed air.

1. Thoroughly clean all metal parts in a commercial carburetor cleaner, until all deposits have been removed. Follow cleaner manufacturer's instructions for proper cleaning and rinsing procedure. Dry parts with compressed air.
2. Using compressed air, blow out all passages in carburetor to remove any foreign material.
3. Wipe off all parts that cannot be cleaned in carburetor cleaner with a clean, dry cloth.
4. Carefully inspect *all* carburetor parts for wear and damage; pay particular attention to the following:
   a. **Float Needle and Seat**: If float needle or seat is worn or damaged, replace with new needle and seat assembly.

IMPORTANT: Float needle and seat are factory matched and tested and should be replaced as a set only.

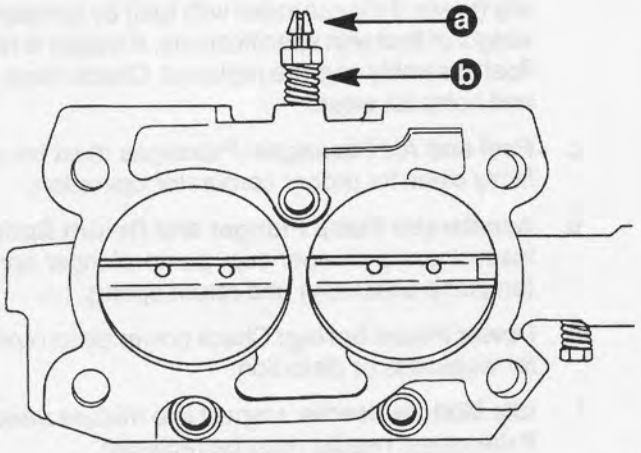
   b. **Float Assembly and Hinge Pin:** Check float density (to see if it is saturated with fuel) by comparing weight of float with specifications. If weight is high, float assembly must be replaced. Check hinge pin and holes for wear.
   c. **Fuel and Air Passages:** Passages must be perfectly clean for proper carburetor operation.
   d. **Accelerator Pump Plunger and Return Spring:** Inspect pump plunger cup, pump plunger spring (on pump assembly) and return spring.
   e. **Power Piston Spring:** Check power piston spring for weakness or distortion.
   f. **Idle Mixture Needle:** Inspect idle mixture needle. If damaged, needle must be replaced.
   g. **Levers and Linkages:** Check levers, links and rods for wear.
   h. **Throttle Valve and Shaft:** Check throttle shaft for excessive looseness in throttle body. Check throttle valve and shaft for binding through entire operating range, making sure valve opens and closes completely. Throttle body assembly must be replaced if throttle valve and shaft are worn or damaged.
   i. **Choke Valve and Shaft and Lever Assembly:** Check shaft and lever assembly for excessive looseness in air horn assembly. Check choke valve and shaft and lever assembly for binding through entire operating range, making sure valve opens and closes completely. Air horn assembly must be replaced if choke valve and shaft and lever assembly are worn or damaged.
   j. **Inspect Casting** for visible damage. Inspect gasket surfaces. Inspect accelerator pump plunger well for scoring or deposits.

Reassembly

THROTTLE BODY ASSEMBLY

IMPORTANT: DO NOT force idle mixture needle against seat as damage to needle and/or seat will result.

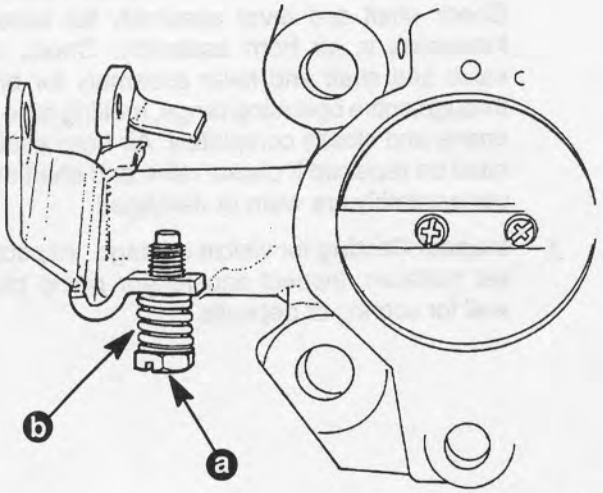
1. Screw idle mixture needle (and spring) into throttle body until they lightly seat, then back out needle 1-1/4 turns as a preliminary idle mixture setting. Final adjustment will be made with engine running. Refer to "Adjustments."



72293

a - Idle Mixture Adjusting Needle
b - Spring

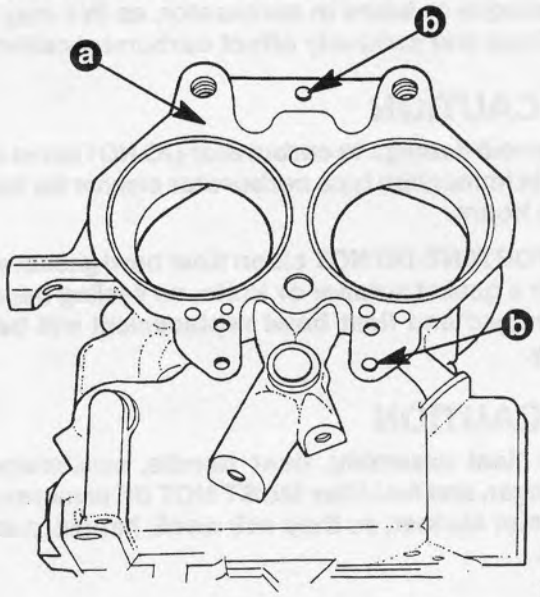
2. Thread idle speed adjustment screw and spring into throttle lever.



72395

a - Idle Speed Screw
b - Spring

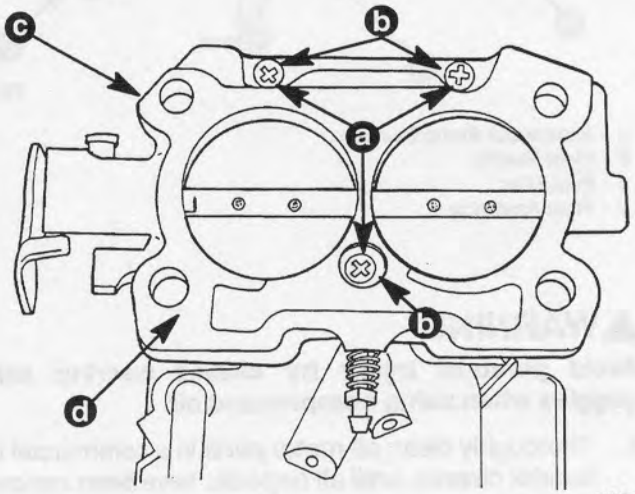
3. Turn float bowl assembly upside down and place new throttle body gasket on bowl, making sure gasket is properly positioned on location dowels.



72295

a - Throttle Body Gasket
b - Locating Dowels

4. Install throttle body assembly on float bowl assembly, making sure that screw holes in gasket line up with screw holes in throttle body. Tighten screws evenly and securely.



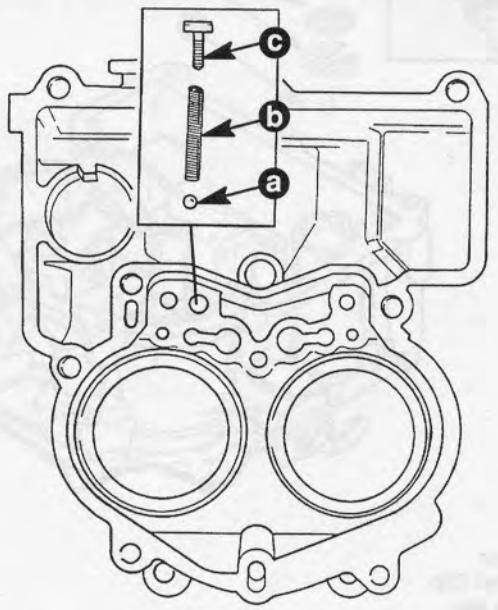
72294

a - Screws
b - Lockwashers (Not Shown)
c - Throttle Body Assembly
d - Gasket

FLOAT BOWL ASSEMBLY

IMPORTANT: Place float bowl and throttle assemblies in holding fixture to prevent throttle valves from being damaged.

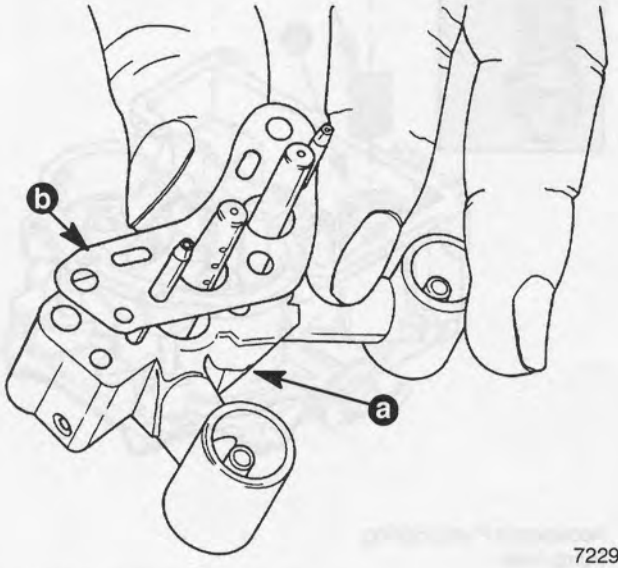
1. Install check ball, spring, and retainer in passage as shown. Push retainer firmly into slots.



72408

a - Check Ball
b - Spring
c - Retainer

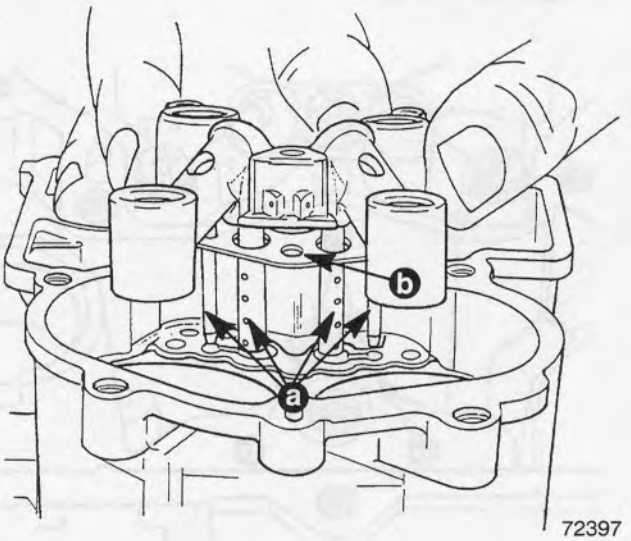
2. Install new gasket on venturi cluster as shown.



72296

a - Venturi Cluster
b - Gasket

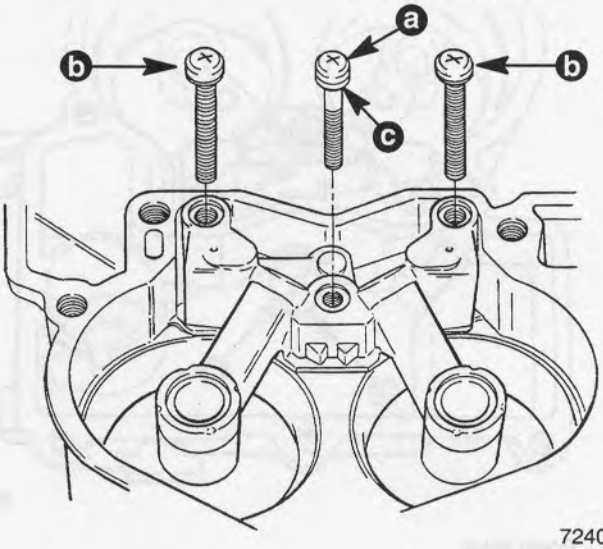
3. Install venturi cluster in carburetor as shown.



72397

a - Venturi Cluster
b - Gasket

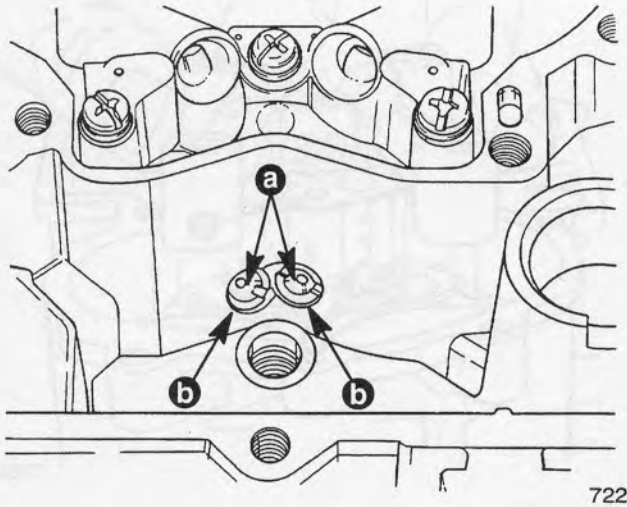
4. Install flat washer and new fiber washer on center screw. Lockwashers and flat washers are used on outer screws. Tighten screws evenly and securely.



72405

a - Center Screw
b - Outside Screws
c - Fiber Washer

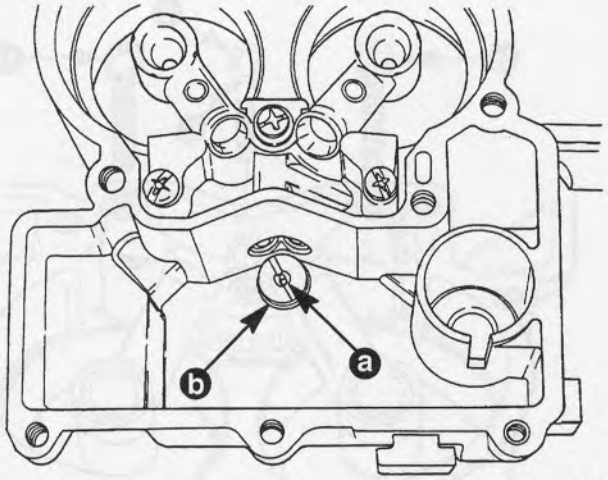
5. Install main metering jets with gaskets as shown. Tighten securely.



72291

a - Main Metering Jets
b - Gaskets (Not Shown)

6. Install power valve with new gasket. Tighten securely.

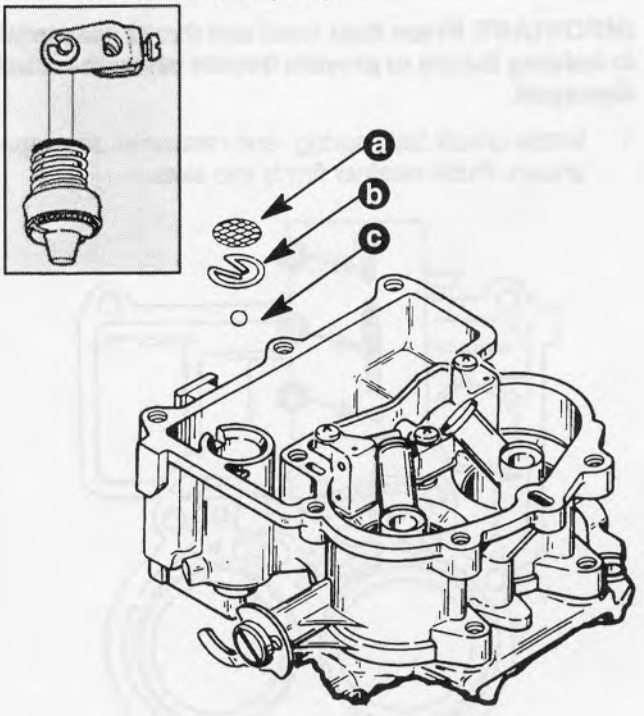


72404

a - Power Valve
b - Gasket (Not Shown)

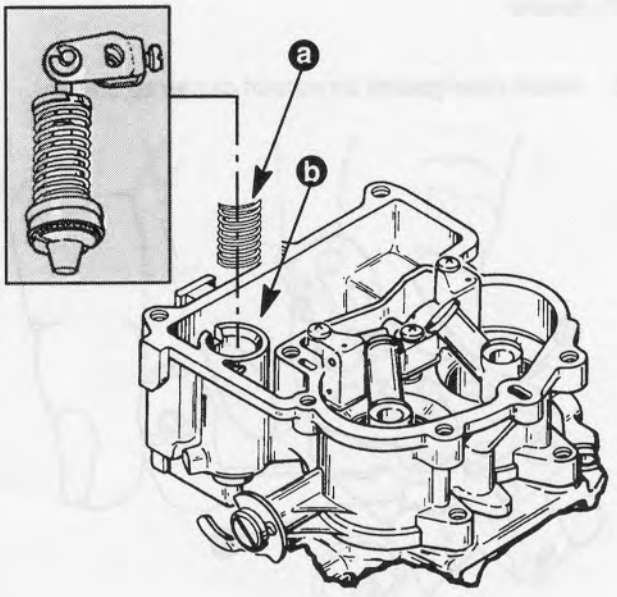
7. Place accelerator pump spring in pump well.

a. 2 cc accelerator pump



a - Strainer
b - Retainer Clip
c - Check Ball

b. 4cc accelerator pump

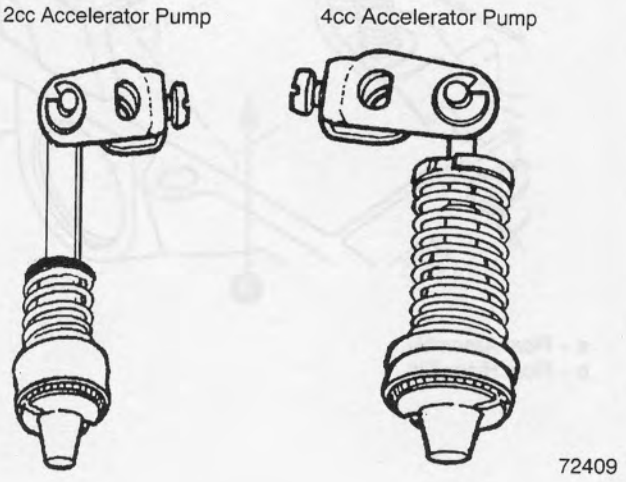


a - Accelerator Pump Spring
b - Pump Well

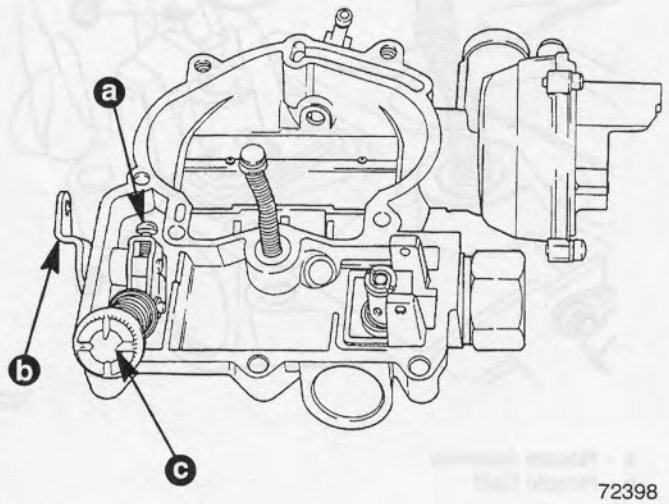
AIR HORN ASSEMBLY

IMPORTANT: Accelerator pump assembly MUST BE installed correctly. If pump assembly is installed incorrectly, top of pump assembly will contact air horn casting.

1. If accelerator pump assembly was removed from pump lever, secure pump assembly to pump lever with washer and retainer clip, as shown.

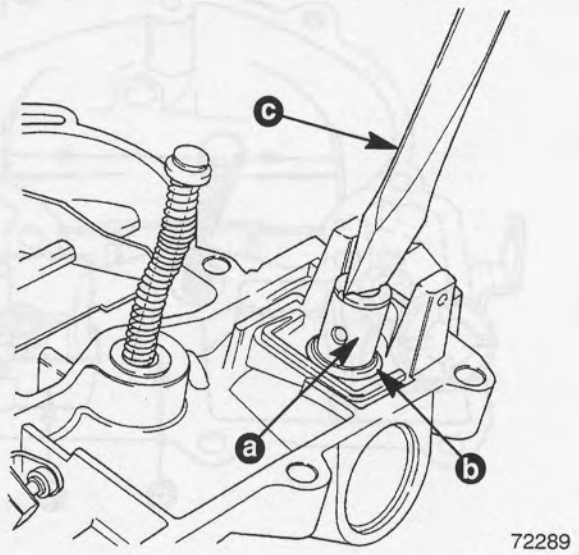


2. Insert pump shaft and lever assembly (and washer) into air horn; then, align indexed hole in pump lever with shaft and lever assembly and slide shaft all the way into lever so that shoulder on shaft is hitting lever. Tighten setscrew securely.



a - Setscrew
b - Lever Assembly
c - Pump Assembly

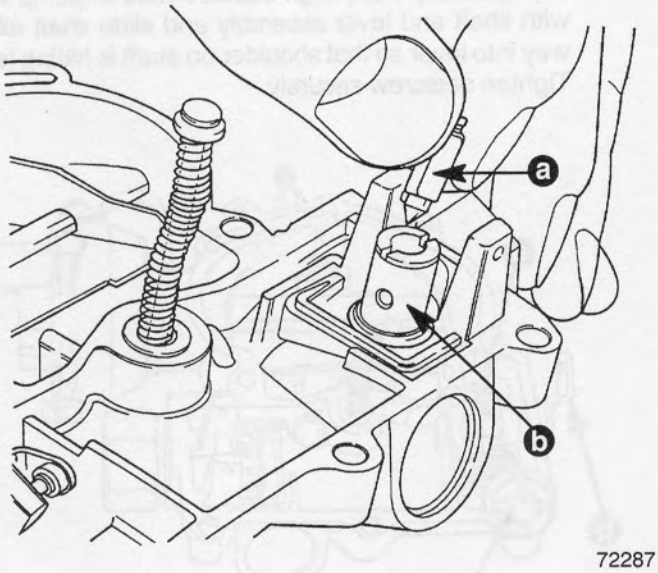
3. Install needle seat and gasket. Tighten securely.



a - Needle Seat
b - Gasket
c - Screwdriver

IMPORTANT: Float needle and needle seat are factory matched and tested and should be replaced as a set only.

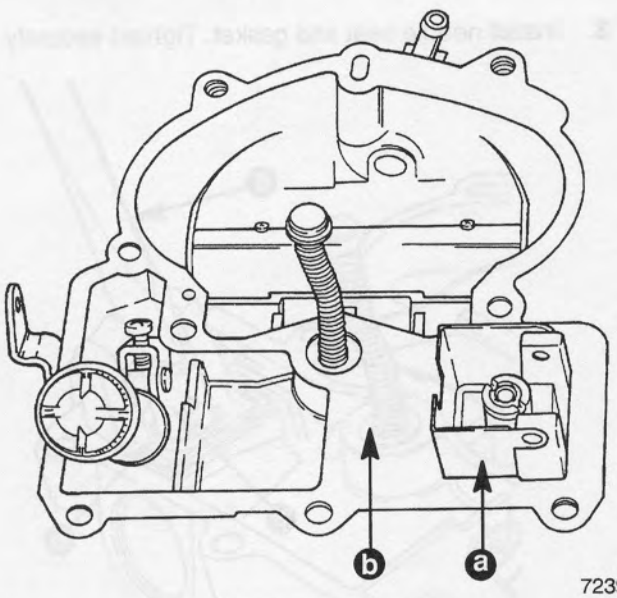
4. Place needle assembly in needle seat.



72287

a - Needle Assembly
b - Needle Seat

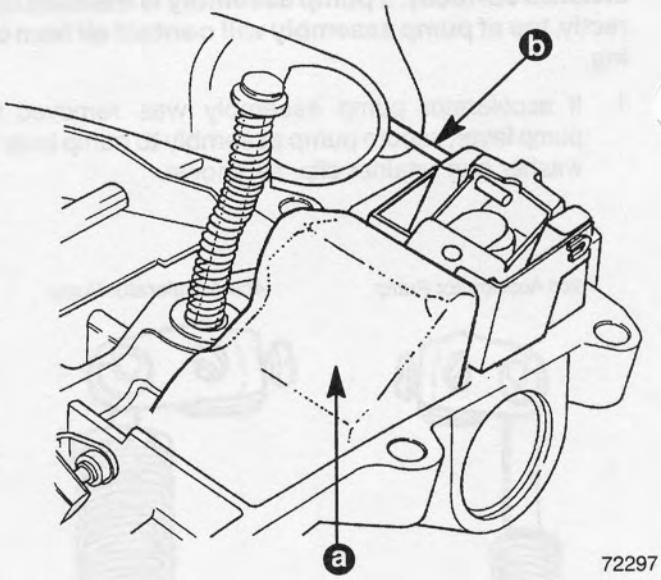
5. Install baffle and gasket.



72399

a - Baffle
b - Gasket

6. Install float assembly and hinge pin. Pivot float assembly up and down on hinge pin to ensure it moves freely.



72297

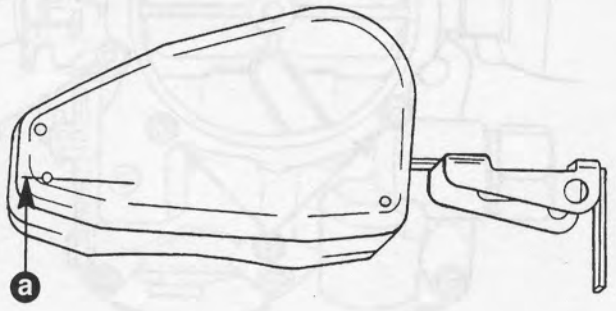
a - Float Assembly
b - Float Hinge Pin

FLOAT LEVEL

1. Turn air horn upside down. Pivot float assembly up and down on hinge pin to ensure it moves freely.

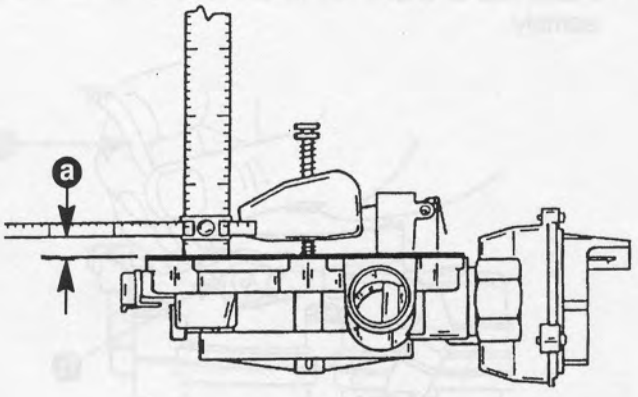
IMPORTANT: Before checking float level, raise float and allow it to fall; however, DO NOT force downward by hand.

2. Measure float level using Universal Carburetor Gauge (P/N 91-36392). Measure from gasket to toe of float.



72298

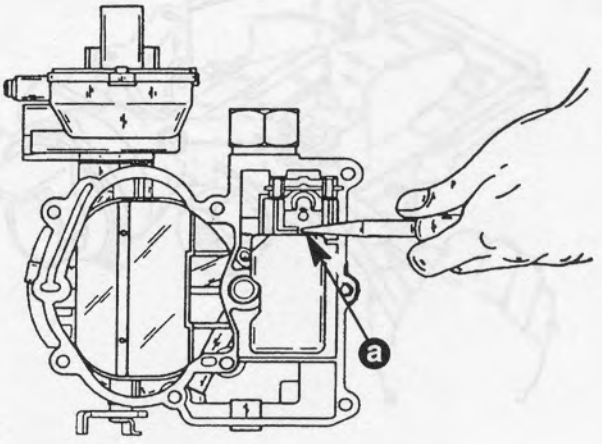
a - Measure from This Point to Gasket



72687

a - Measurement With 2 Piece Solid Inlet Needle - 3/8 in. (10 mm)
Measurement With Spring Loaded Inlet Needle - 9/16 in. (14 mm)

3. Bend float arm up or down at point shown to obtain specified dimension.



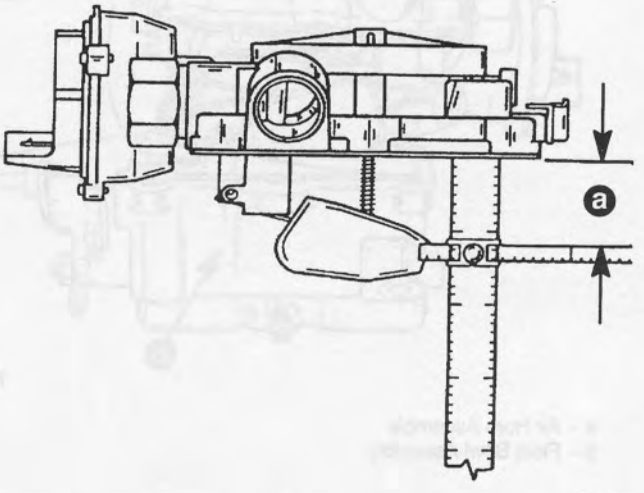
72688

a - Bend Float Arm at This Point

4. Visually check float alignment after adjustment.

FLOAT DROP

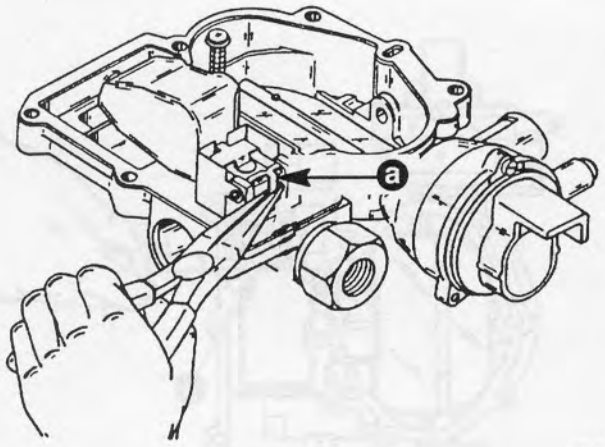
1. Hold air horn right side up to allow float to hang free.
2. Measure float drop using Universal Carburetor Gauge (P/N 91-36392). Measure from gasket to toe of float.



72689

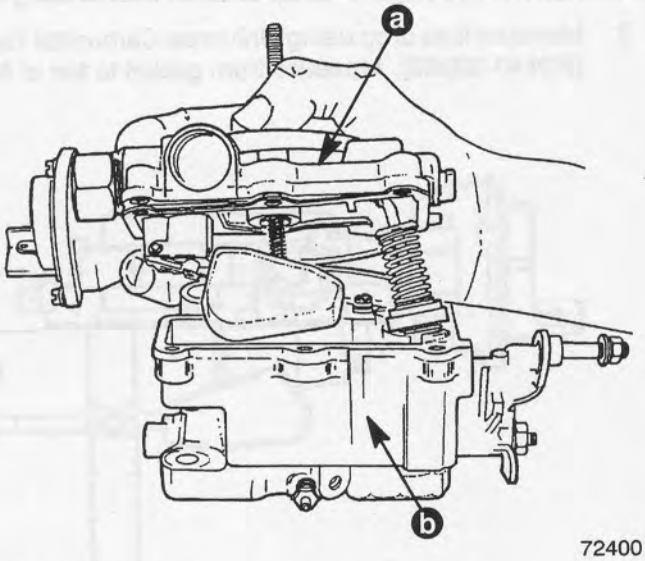
a - Measurement - 1-3/32 in. (27 mm)

3. Bend float assembly tang, as shown, to obtain specified dimension.



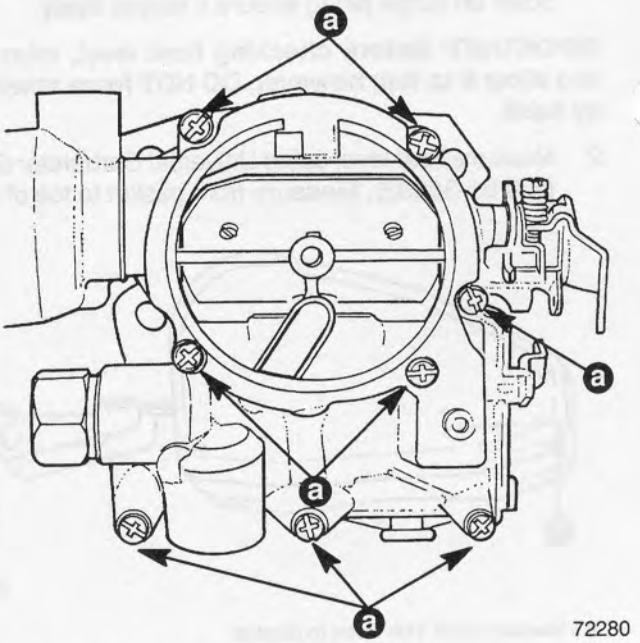
a - Float Assembly Tang

4. Recheck BOTH float level and float drop.
5. Carefully place air horn on float bowl, making sure accelerator pump is correctly positioned in fuel well. Lower air horn straight down to install.



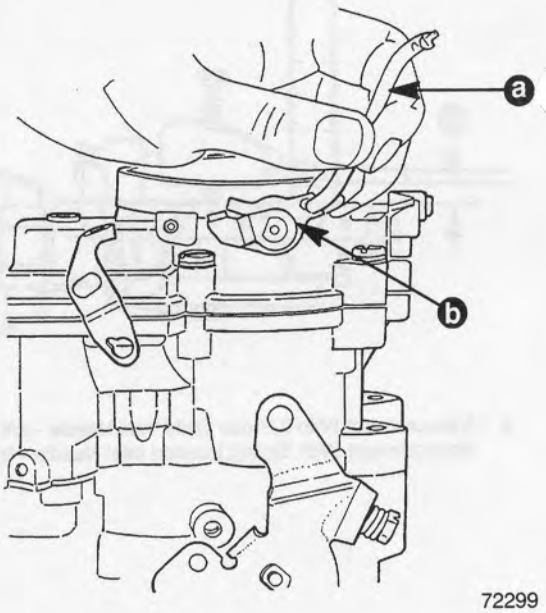
a - Air Horn Assembly
b - Float Bowl Assembly

6. Install seven short and one long air horn attaching screws. Tighten screws evenly and securely.



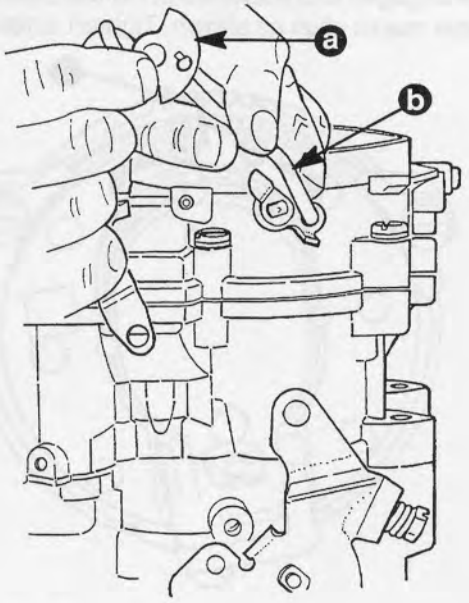
a - Air Horn Attaching Screws

7. Place end of choke rod in choke lever and collar assembly.



a - Choke Rod
b - Choke Lever and Collar Assembly

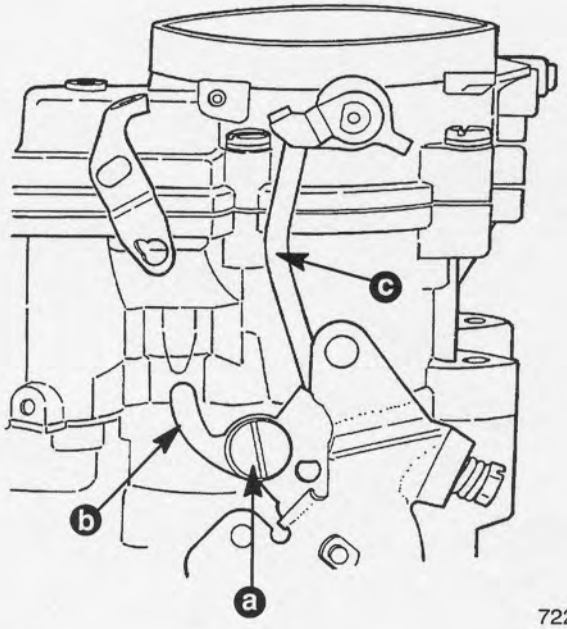
8. Place idle cam on choke rod.



72392

a - Idle Cam
b - Choke Rod

9. Secure idle cam (with choke rod installed on cam) on float bowl assembly, using screw. Check that cam is free to move without binding.

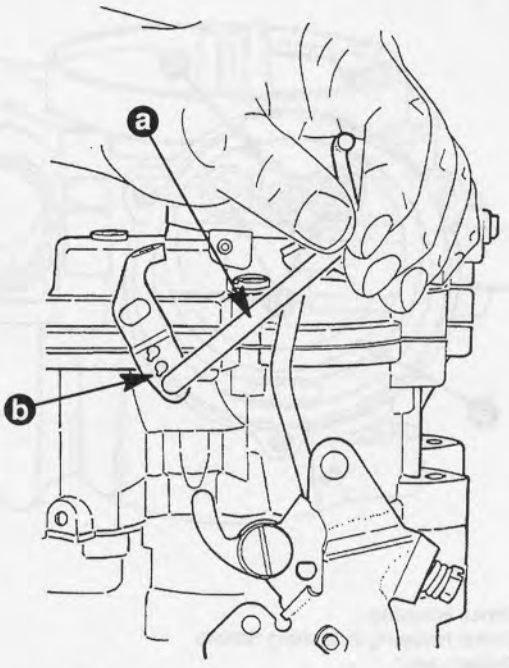


72282

a - Screw
b - Idle Cam
c - Choke Rod

IMPORTANT: Before performing the following step, see "Adjustable Accelerator Pump Lever" information listed previously in this section.

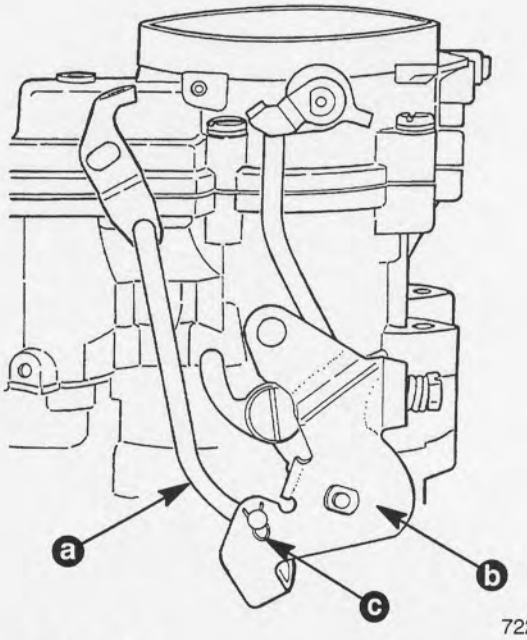
10. Place accelerator pump rod (end with ear) in appropriate hole in pump shaft and lever assembly. If adjustment was not needed, be sure that pump rod is installed in the original hole that it was removed from.



72393

a - Accelerator Pump Rod
b - Pump Shaft and Lever Assembly

11. Insert remaining end of accelerator pump rod into hole in throttle lever and secure with retainer clip.

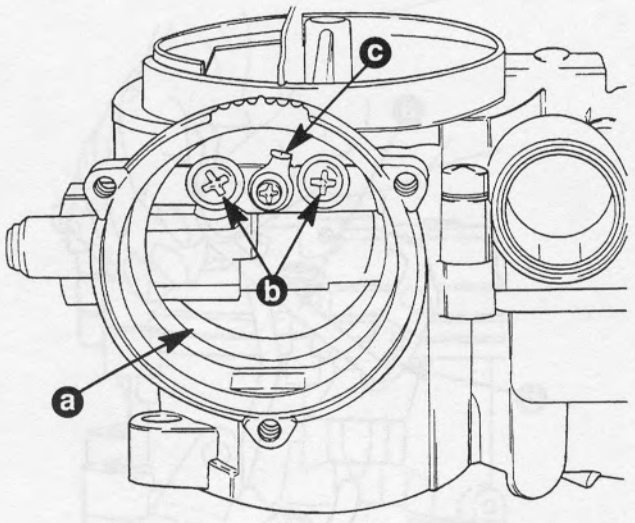


72283

a - Accelerator Pump Rod
b - Throttle Lever
c - Retainer Clip

CHOKE HOUSING ASSEMBLY

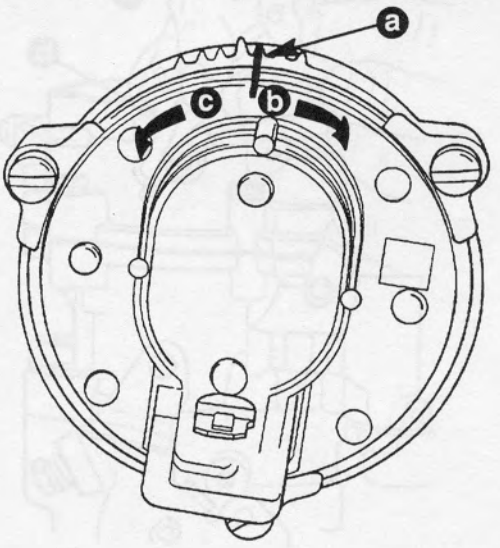
1. Install choke housing on air horn; tighten screws securely. Install choke lever; tighten screw securely.



72401

a - Choke Housing
b - Choke Housing Attaching Screws
c - Choke Lever

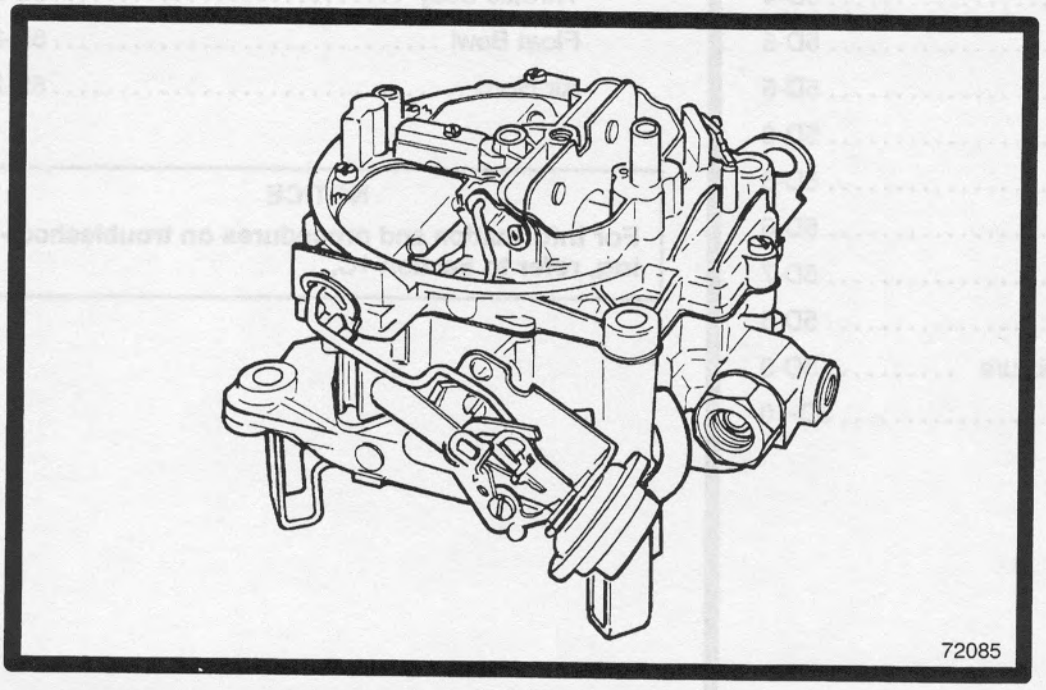
2. Install choke cover. Make sure hook on end of choke coil engages with choke lever. Rotate choke cover until index marks align as shown. Tighten screws securely.



72403

a - Scribed Mark
b - More Choke
c - Less Choke

FUEL SYSTEM



ROCHESTER 4 BARREL CARBURETOR

5

D

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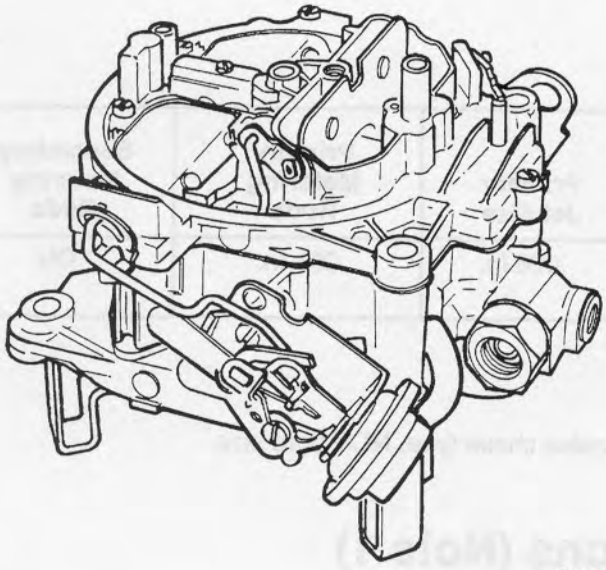
NOTICE

For information and procedures on troubleshooting, refer to Section 1C.

Identification



72085

Replacement Parts Warning

⚠ WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Torque Specifications

Fastener Location	Lbs. Ft. (N•m)	Lbs. In. (N•m)
Carburetor to Manifold		132 (15)
Fuel Line to Carburetor	18 (24)	
Fuel Inlet Filter Nut	18 (24)	

Tools

Part Number	Description
91-36392	Universal Carburetor Gauge
91-59339	Tachometer

Kent-Moore Special Tools

Can be ordered from: Kent-Moore Tools, Inc.
29784 Little Mack
Roseville, MI 48066
Phone: (313) 574-2332

Part Number	Description
J9789-118	Carburetor Stand
J22769	Needle Valve Seat Remover

Wagner Special Tools

Can be ordered from: Wagner Instruments
P.O. Box 1217
Greenwich, CT 06836
Phone: (203) 869-9681

Part Number	Description
Model G.D. 150	Gram Scale (with Round Tip)

Borroughs Special Tools

Can be ordered from: Borroughs Tool & Equip. Corp.
2429 N. Burdick Street
Kalamazoo, MI 48007
Phone: (616) 345-5163

Part Number	Description
BT-8128 B	Float Scale
BT-8420 A	Float Level Gauge

TORX® SCREWDRIVERS

Rochester Quadrajet carburetors have a "star" shaped socket in the head of the screw. A TORX® screwdriver must be used on this type of screw. The three sizes used are #9, #20, and #25.

Carburetor Specifications

Model	Carb Type (Note)	Mercury No. (Manufacturer No.)	Primary Jet Size	Primary Metering Rods	Secondary Metering Rods
MCM 185, 205, 4.3LX	Rochester 4MV	3300-8886, 3304-9354	.066 In.	.036 In.	DH

NOTE: Rochester Quadrajets are 4MV type. The "V" or "C" designates choke type, NOT bore size.

Carburetor Adjustment Specifications (Note 1)

UNIT OF MEASUREMENT
In. (mm)

Engine Model	MCM 5.0LX
Make & Model	Rochester 4MV
Carburetor Manufacturer Number	17083515 17084516
Float Level	15/64 (5.9)
Pump Rod Hole Location	Inner
Accelerator Pump (Note 2)	23/64 (9.1)
Air Valve Dashpot (Air Valve Rod)	.025 (0.64)
Vacuum Break	.080 [5/64] (2.0)
Air Valve Spring Windup	1/4 Turn 40-50 GR.
Choke Coil Rod (Note 3)	Top of Rod Even with Bottom of Hole
Idle Mixture Screw Preliminary Setting	2-3 Turns
Float Weight (Max)	9.88 GR.

NOTE 1: All measurements are ± 1/64 in. (0.4mm).
NOTE 2: Accelerator pump measurement taken from flame arrestor surface to pump stem with throttle plates closed.
NOTE 3: Choke valve must be closed, choke rod in bottom of choke lever slot, and choke coil rod pushed down to end of travel.

Description

The Quadrajet carburetor has two stages in operation. The primary (fuel inlet) side has small bores with a triple venturi set-up equipped with plain tube nozzles. Its metering principles are similar to most plain tube carburetors which use the venturi principle. The triple venturi stack-up, plus smaller primary bores, give a more stable and finer fuel control in idle and economy ranges of operation. Fuel metering in primary side is accomplished with tapered metering rods positioned by a manifold vacuum responsive piston.

Secondary side has two very large bores which have greatly increased air capacity to meet present and future engine demands. Air valve principle is used in secondary side for metering control and supplements fuel flow from primary bores.

Using air valve principle, fuel is metered in direct proportion to air passing through secondary bores.

Fuel reservoir is centrally located to avoid problems of fuel slosh causing engine turn cut-out and delayed fuel to carburetor bores. Float system uses a single float pontoon for ease in servicing the unit.

Precautions

⚠WARNING

Always disconnect battery cables from battery BEFORE working on fuel system to prevent fire or explosion.

⚠WARNING

Be careful when cleaning flame arrestor and crankcase ventilation hose; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is OFF. DO NOT smoke or allow sources of spark or open flame in area when cleaning flame arrestor and crankcase ventilation hose.

⚠WARNING

Be careful when changing fuel system components; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is OFF. DO NOT smoke or allow sources of spark or flame in the area while changing fuel filter. Wipe up any spilled fuel immediately.

⚠WARNING

Make sure no fuel leaks exist before closing engine hatch.

⚠CAUTION

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

Maintenance

Flame Arrestor

NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

1. Remove (in the following order):
   a. Nut
   b. Sealing washer
   c. Carburetor cover
   d. Sta-Strap hose retainers and crankcase ventilation hoses from flame arrestor and rocker arm covers.
   e. Flame arrestor (lift from carburetor)

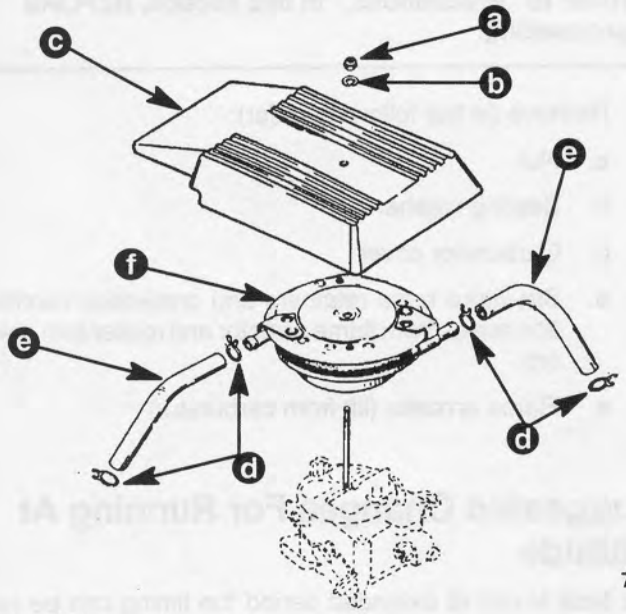
Suggested Changes For Running At Altitude

If a boat is run at extended period the timing can be retarded 2 degrees for every 5000 ft. (1525 m) and/or change secondary metering rods. The recommended rods are listed below.

Model	5000 ft (1525 m) And Below	5000-9000 ft (1525 -2745m)	9000 ft (2745 m) And Above
185 ,205 4.3LX	ED	CL	CT

Rochester Part Numbers			
Meter Rods Letters	ED 17081095	CL 7045782	CT 7045983

2. Clean and Inspect:
   a. Clean flame arrestor in solvent and blow dry with compressed air.
   b. Clean crankcase ventilation hoses.
   c. Inspect crankcase ventilation hose for cracks or deterioration; replace if necessary.
3. Install (in the following order):
   a. Flame arrestor (place on carburetor)
   b. Crankcase ventilation hose and Sta-Strap hose retainers (to flame arrestor and rocker arm covers)
   c. Carburetor cover
   d. Sealing washer
   e. Nut (tighten securely)



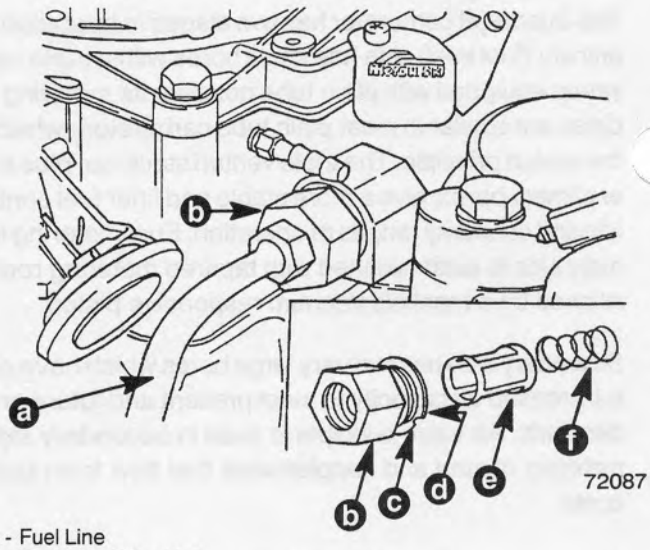
a - Nut
b - Sealing Washer
c - Carburetor Cover
d - Sta-Strap
e - Crankcase Ventilation Hose
f - Flame Arrestor

Fuel Filter

NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

1. Remove:
   - Fuel line from fuel inlet filter nut
   - Fuel inlet filter nut
   - Large gasket
   - Filter
   - Spring
   - Small gasket (from inside filter nut)



a - Fuel Line
b - Fuel Inlet Filter Nut
c - Gasket (Large)
d - Gasket (Small)
e - Filter
f - Spring

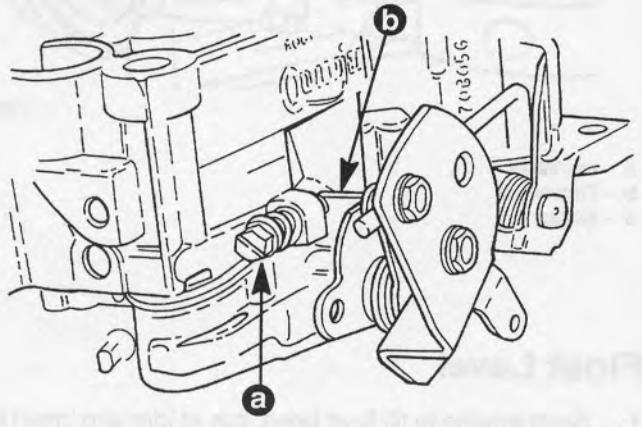
2. Clean filter nut and spring.
3. Install the following:
   - Spring (place in carburetor body)
   - Filter (open end to inlet filter nut)
   - Small gasket (place inside filter nut)
   - Large gasket (place over filter nut)
   - Fuel inlet filter nut (tighten to 18 lb. ft. (24 N•m)
   - Fuel line (tighten to 18 lb. ft. (24 N•m)

Adjustments

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

Accelerator Pump

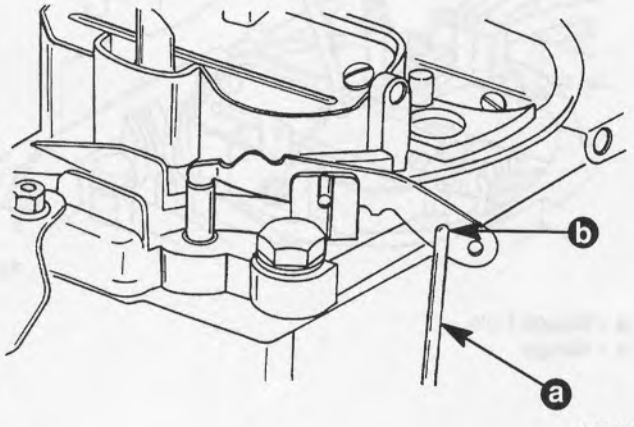
1. Back out idle stop screw until it no longer contacts throttle lever.



72081

a - Idle Stop Screw
b - Throttle Lever

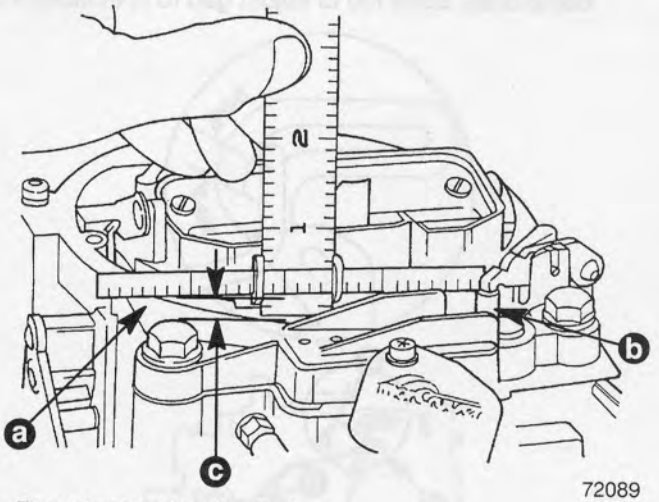
2. Pump rod must be in inner hole of lever.



72088

a - Pump Rod
b - Inner Hole

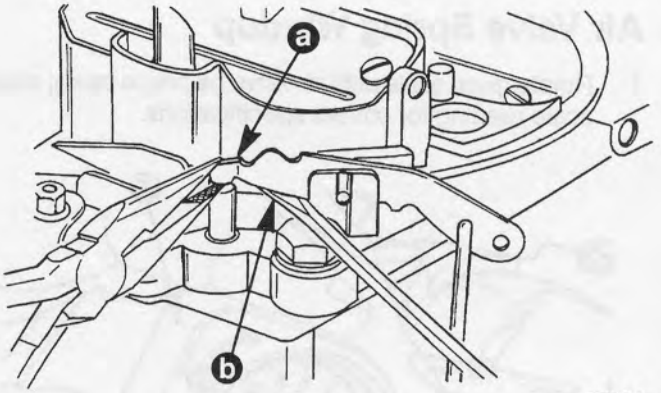
3. Close throttle valves completely and measure from flame arrestor mounting surface to top of pump plunger stem.



72089

a - Flame Arrestor Mounting Surface
b - Pump Plunger Stem
c - See Specifications

4. While supporting lever, bend tip of pump lever to obtain specified dimension in Step 3.

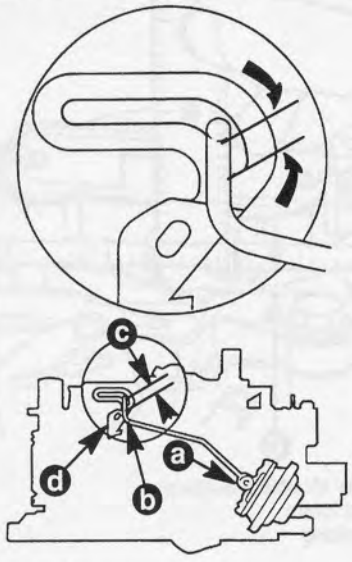


72090

a - Tip of Pump Lever
b - Support as Shown

Air Valve Dashpot

1. Seat vacuum break diaphragm and close air valve completely. Bend rod to adjust gap to specifications.

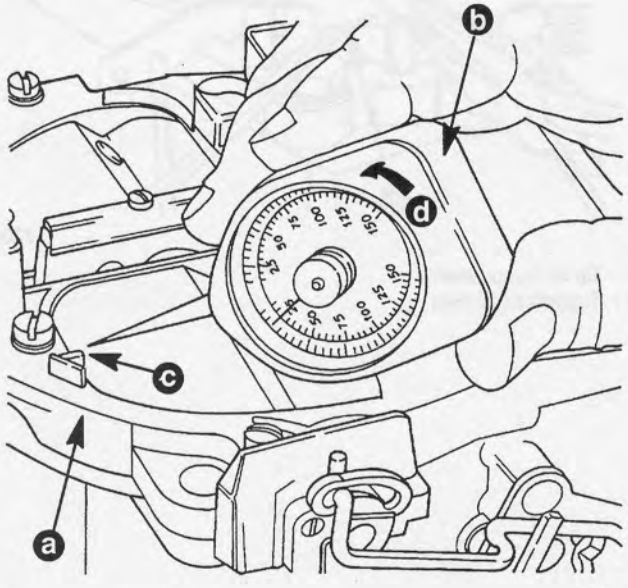


72091

a - Push in Completely
b - Bend Here to Adjust
c - Specified Gap
d - Fully Closed

Air Valve Spring Windup

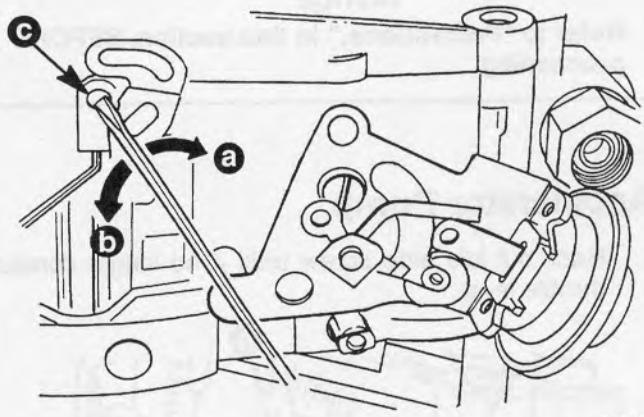
1. Rotate gram scale until air valve begins to open; check scale reading for correct specifications.



72092

a - Carburetor Casting
b - Gram Scale
c - Contact Area of Arm on Air Valve
d - Rotate

2. To adjust spring windup, hold tension spring screw and loosen Allen head screw.
3. Adjust tension and retighten Allen screw securely.

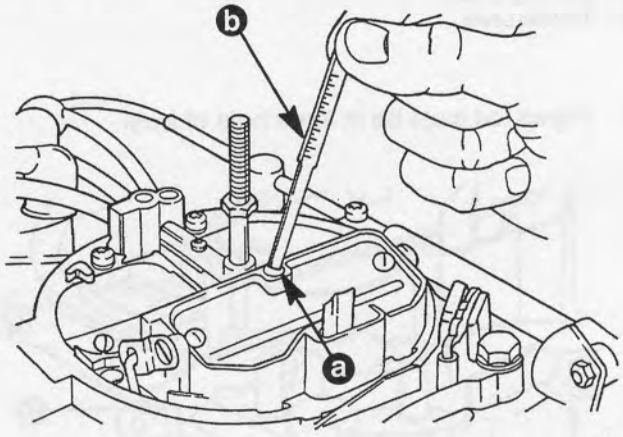


72093

a - Increase
b - Decrease
c - Screw

Float Level

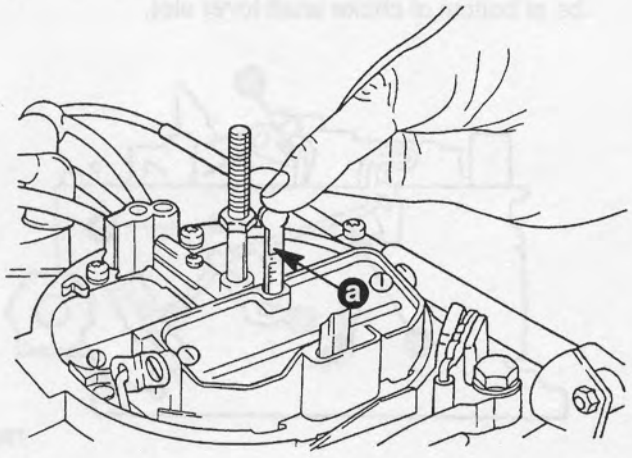
1. Start engine to fill float bowl, run at idle and insert float gauge into hole next to flame arrestor stud.



72083

a - Gauge Hole
b - Gauge

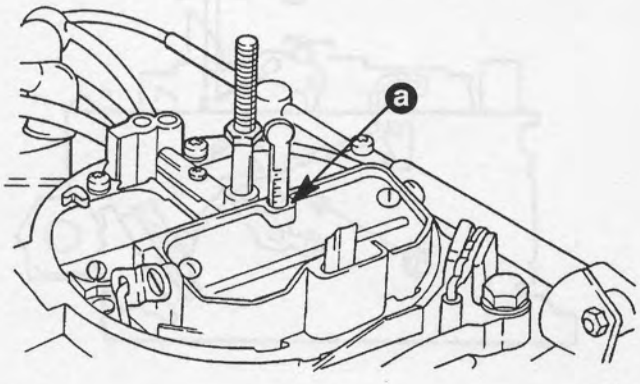
2. Tap float gauge down lightly to assure free movement.



72082

a - Gauge

3. Take gauge reading at top of carburetor casting.



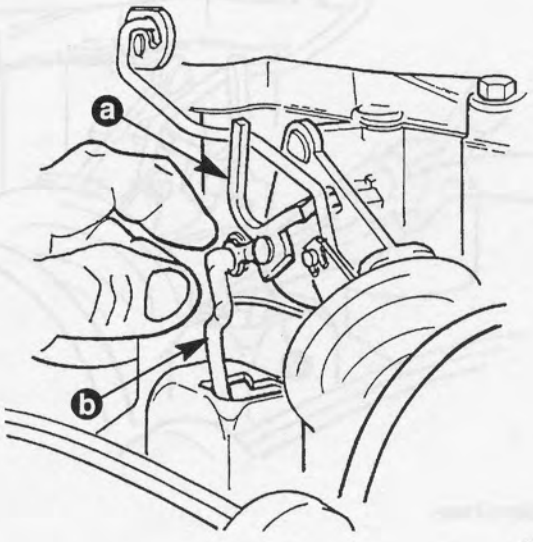
72084

a - Read Here

4. If float requires adjustment, refer to "Reassembly" later in this section, for adjustment procedure.

Choke Coil Rod

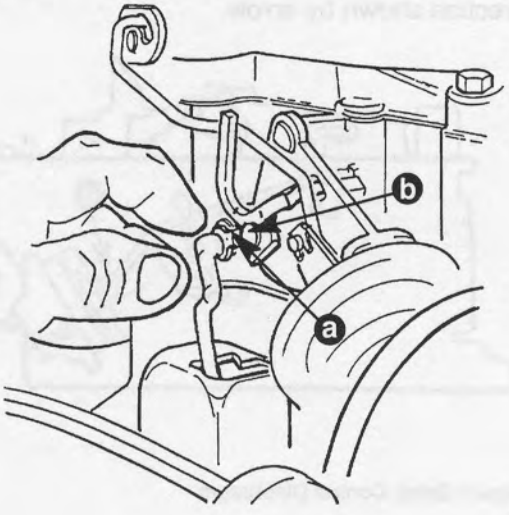
1. Push choke coil rod down.



72096

a - Vacuum Break Choke Lever
b - Choke Coil Rod

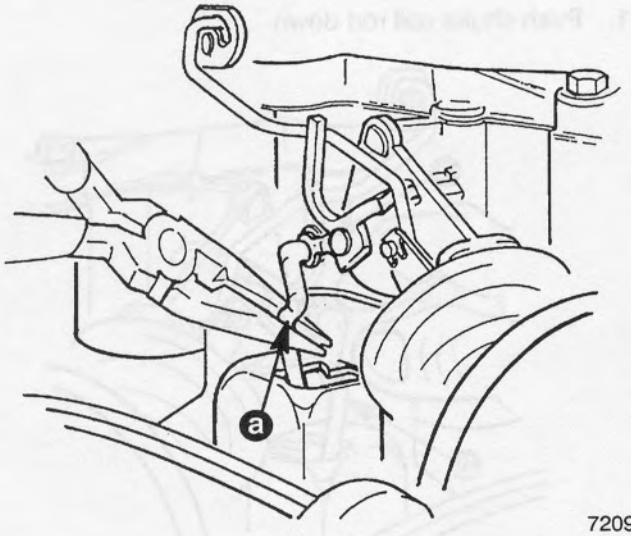
2. Choke coil rod top must be even with bottom of hole in vacuum break choke lever.



72096

a - Top of Rod
b - Bottom of Hole

3. Bend rod to adjust.

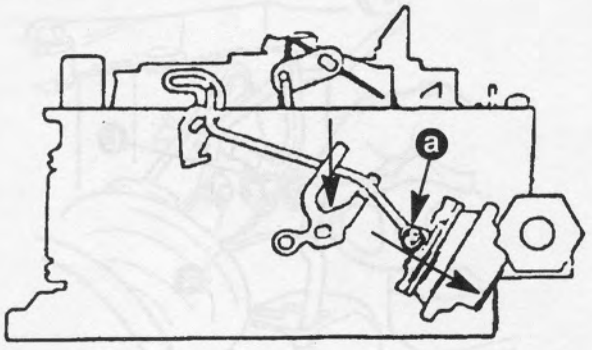


72095

a - Bend Here

Vacuum Break

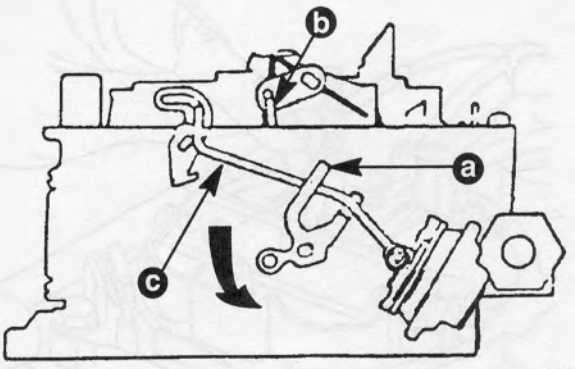
1. Seat vacuum break control diaphragm by pushing in direction shown by arrow.



72097

a - Vacuum Break Control Diaphragm

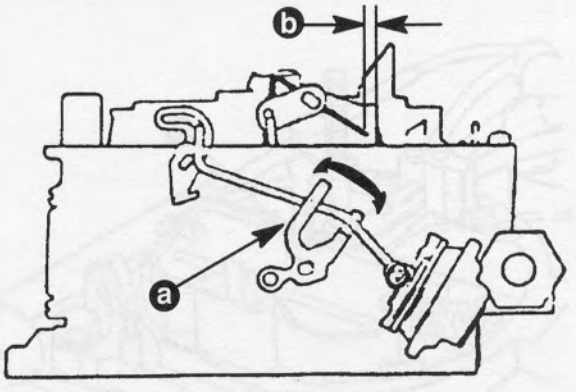
2. Rotate vacuum break choke lever counterclockwise until tang contacts vacuum break rod. Choke rod must be at bottom of choke shaft lever slot.



72097

a - Tang
b - Choke Rod
c - Vacuum Break Rod

3. Bend tang as necessary to obtain specified choke valve gap of 5/64 [.08] in. (2.0 mm).



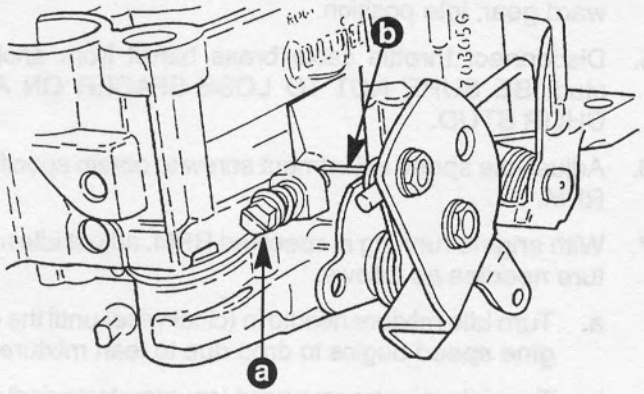
72097

a - Tang
b - Gap

Preliminary Idle Speed and Mixture

Initial start setting; make final adjustments with engine running.

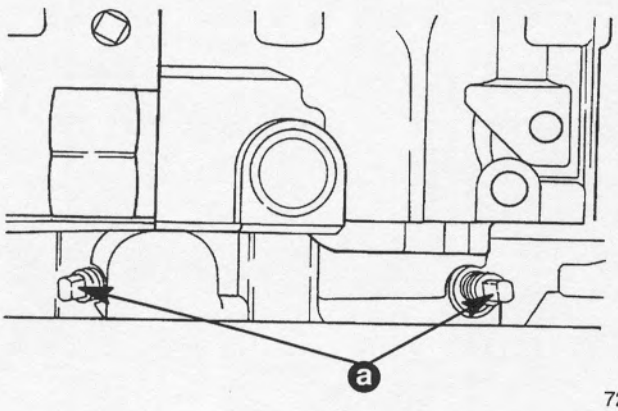
1. Turn idle stop screw out until it does not contact throttle lever, then turn in until it just contacts throttle lever.



72081

a - Idle Stop Screw
b - Throttle Lever

2. Turn idle needles until LIGHTLY seated then back out 2 to 3 turns.



72098

a - Idle Needles

IMPORTANT: Do not turn idle mixture screws tightly against seat, as damage to seat and/or needle may result.

Final Idle Speed and Mixture

IMPORTANT: Boat MUST BE in the water and engine at normal operating temperature to accurately check and adjust idle speed and mixture.

Carburetor should be set so that engine idles smoothly, with boat in the water, engine at normal operating temperature and drive unit in forward gear. To adjust idle speed and mixture, proceed as follows:

IMPORTANT: DO NOT attempt to compensate for other engine problems (incorrect ignition timing, faulty ignition components, low compression, vacuum leaks, etc.) with carburetor adjustments. This will only cover the problem which must be corrected if engine is to achieve maximum fuel economy and performance.

1. Connect a shop tachometer to engine.

IMPORTANT: DO NOT turn idle mixture needles tightly into seat, as damage to needle and/or seat may result.

2. If a new or rebuilt carburetor has been installed, turn each idle mixture needle until it LIGHTLY contacts seat, then back out 2 or 3 turns. This will provide a sufficient setting to allow starting the engine.
3. Start engine and run at 1500 RPM until engine reaches normal operating temperature.

⚠ WARNING

DO NOT leave the helm unattended while performing idle speed and mixture adjustments, following. BE CAREFUL NOT TO ACCIDENTALLY ACCELERATE ENGINE WHILE PERFORMING ADJUSTMENTS.

4. With boat in open water, place remote control in forward gear, idle position.
5. Disconnect throttle cable brass barrel from anchor stud. BE SURE NOT TO LOSE SPACER ON ANCHOR STUD.
6. Adjust idle speed adjustment screw to obtain specified RPM.
7. With engine running at specified RPM, adjust idle mixture needles as follows:
   a. Turn idle mixture needle in (clockwise) until the engine speed begins to drop due to lean mixture.
   b. Turn idle mixture screw out (counterclockwise) until the speed begins to drop due to a rich mixture.
   c. Turn screw in to a point between these two extremes to obtain maximum engine smoothness and RPM.
   d. Repeat procedure with other needle.
   e. Readjust idle speed adjustment screw, if necessary, to obtain specified RPM.

IMPORTANT: Refer to Section 2 for throttle cable installation and adjustment.

Repair

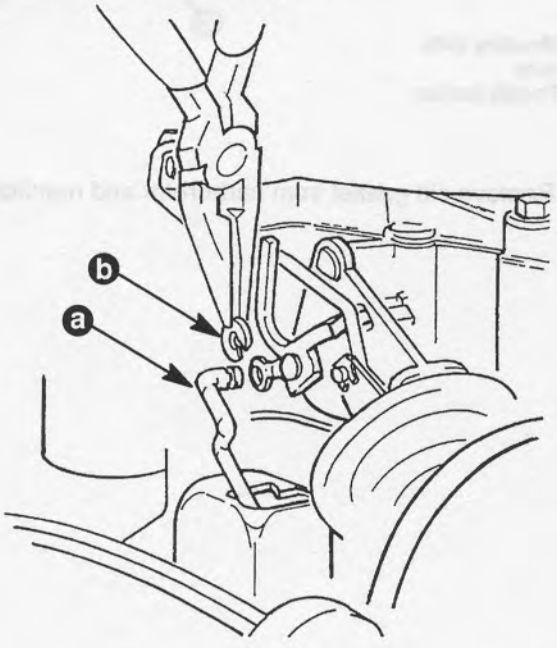
NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

IMPORTANT: Carburetor malfunctions are, in many cases, caused by the presence of dirt, water or other foreign matter in carburetor. To aid in diagnosis, carefully remove carburetor from engine without draining fuel from bowl. Contents of fuel bowl may then be inspected for contamination as carburetor is disassembled.

Removal

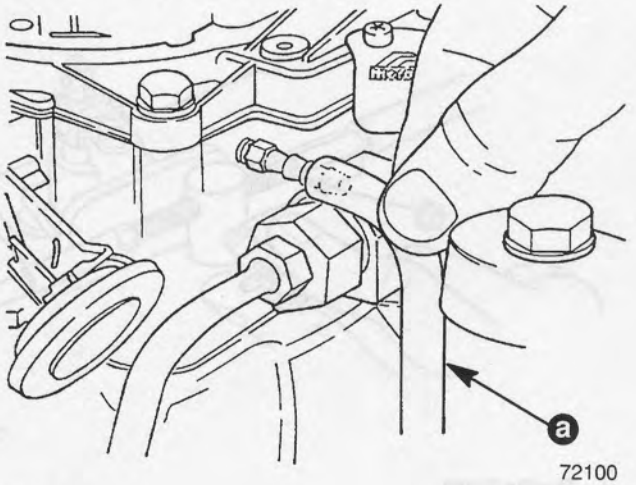
1. Remove flame arrestor.
2. Disconnect choke spring rod.



72099

a - Choke Link
b - Clip

3. Disconnect sight tube (if equipped).

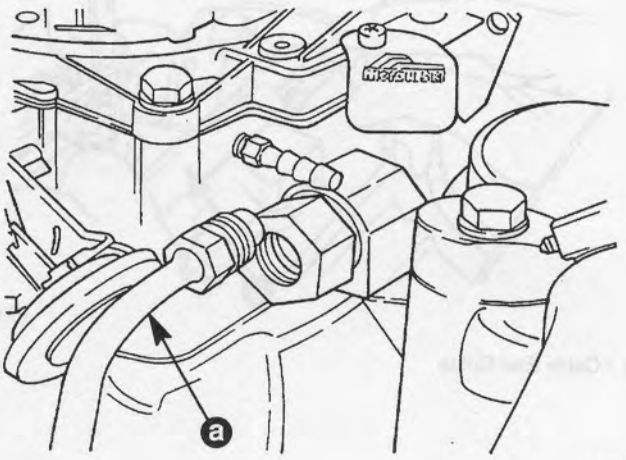


72100

a - Sight Tube

IMPORTANT: Place a clean cloth in bores of carburetor to prevent dirt and foreign material from falling into bores.

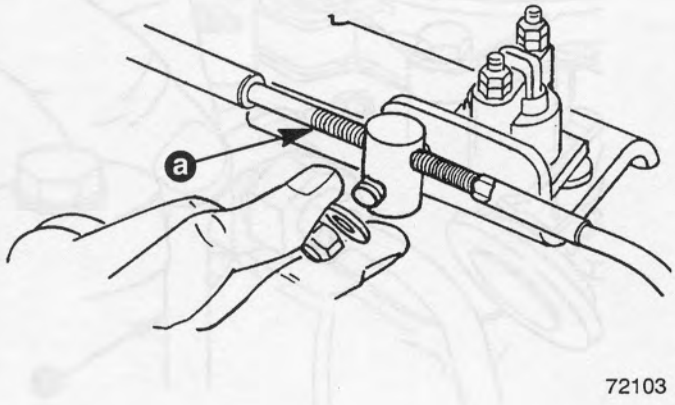
4. Turn off fuel supply at the fuel tank.
5. Disconnect fuel line.



72101

a - Fuel Line

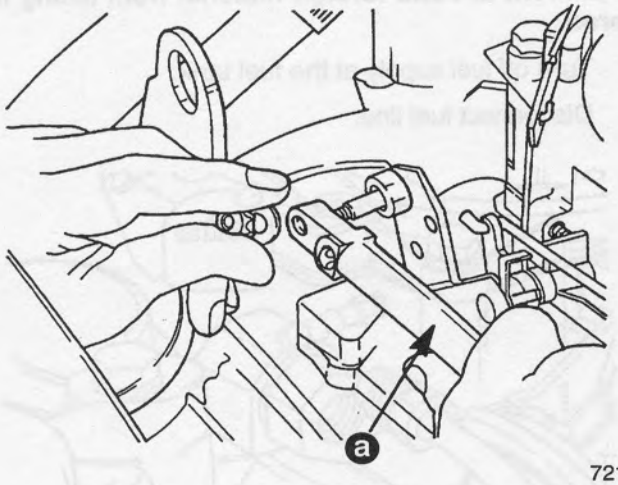
6. Disconnect throttle cable.



72103

a - Throttle Cable

7. Disconnect cable end guide.

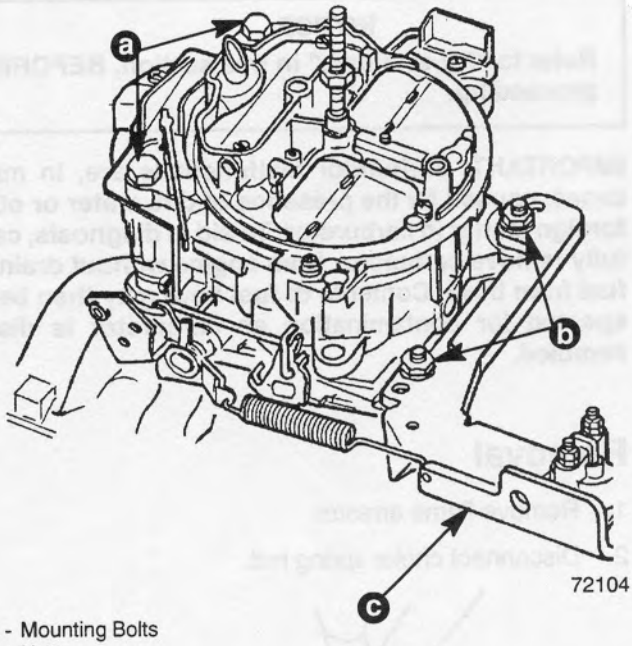


72102

a - Cable End Guide

8. Remove retaining nuts and bolts; remove carburetor and cable bracket.

IMPORTANT: Place a clean cloth over intake manifold opening to prevent dirt or foreign material from entering manifold.



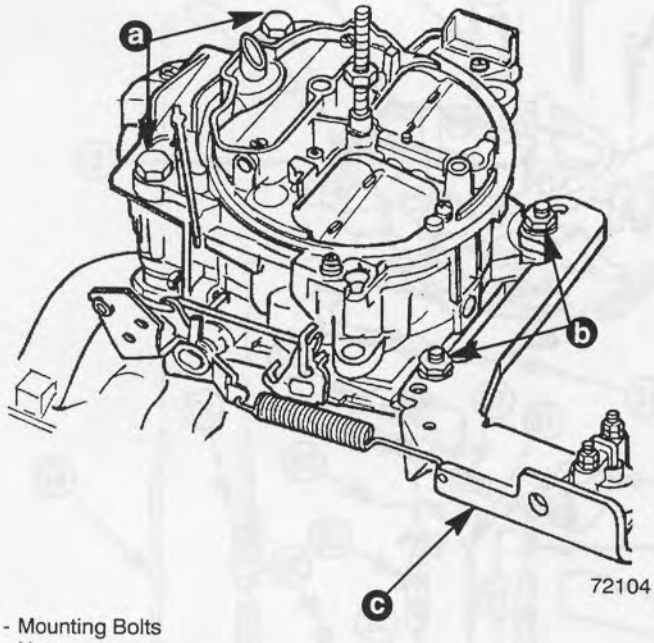
72104

a - Mounting Bolts
b - Nuts
c - Throttle Bracket

9. Remove old gasket from carburetor and manifold.

Installation

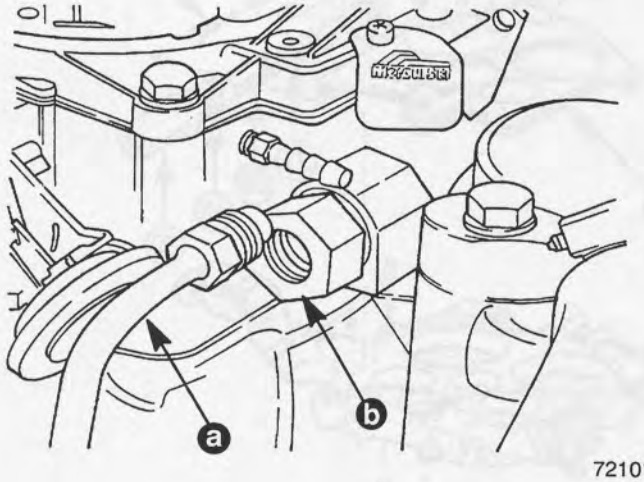
1. Install new gasket onto manifold.
2. Install carburetor and throttle bracket and torque to 132 lb. in. (15 N•m).



72104

a - Mounting Bolts
b - Nuts
c - Throttle Bracket

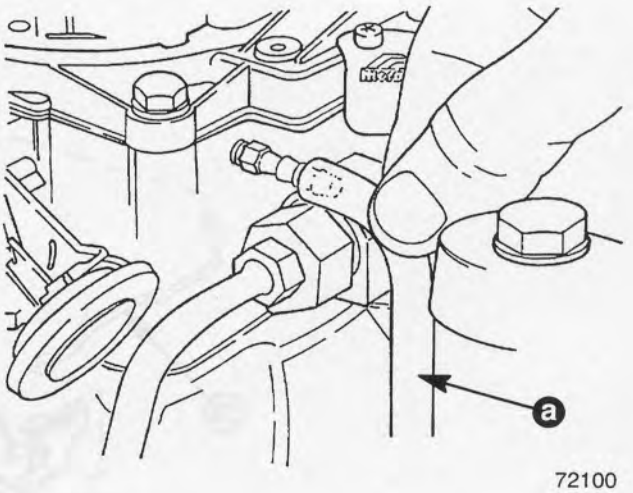
3. Connect fuel line and torque to 18 lb. ft. (24 N•m). To prevent over-tightening, hold brass fuel line coupling with suitable wrench and tighten fuel line connector securely.



72101

a - Fuel Line
b - Fuel Line Coupling

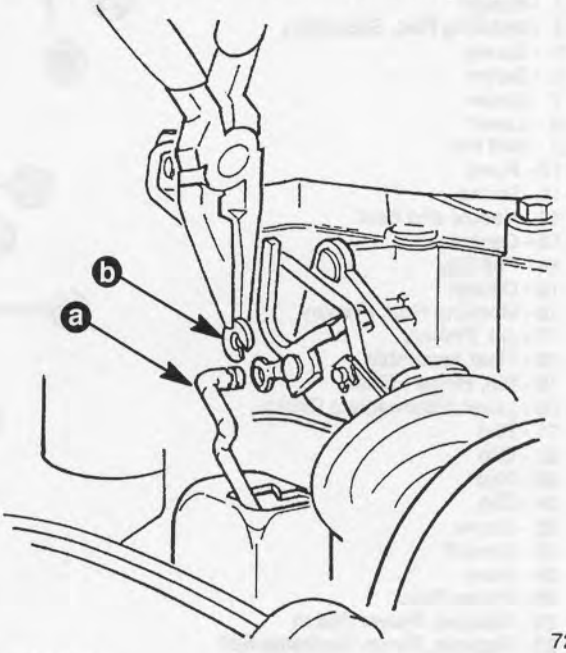
4. Connect fuel sight tube.



72100

a - Sight Tube

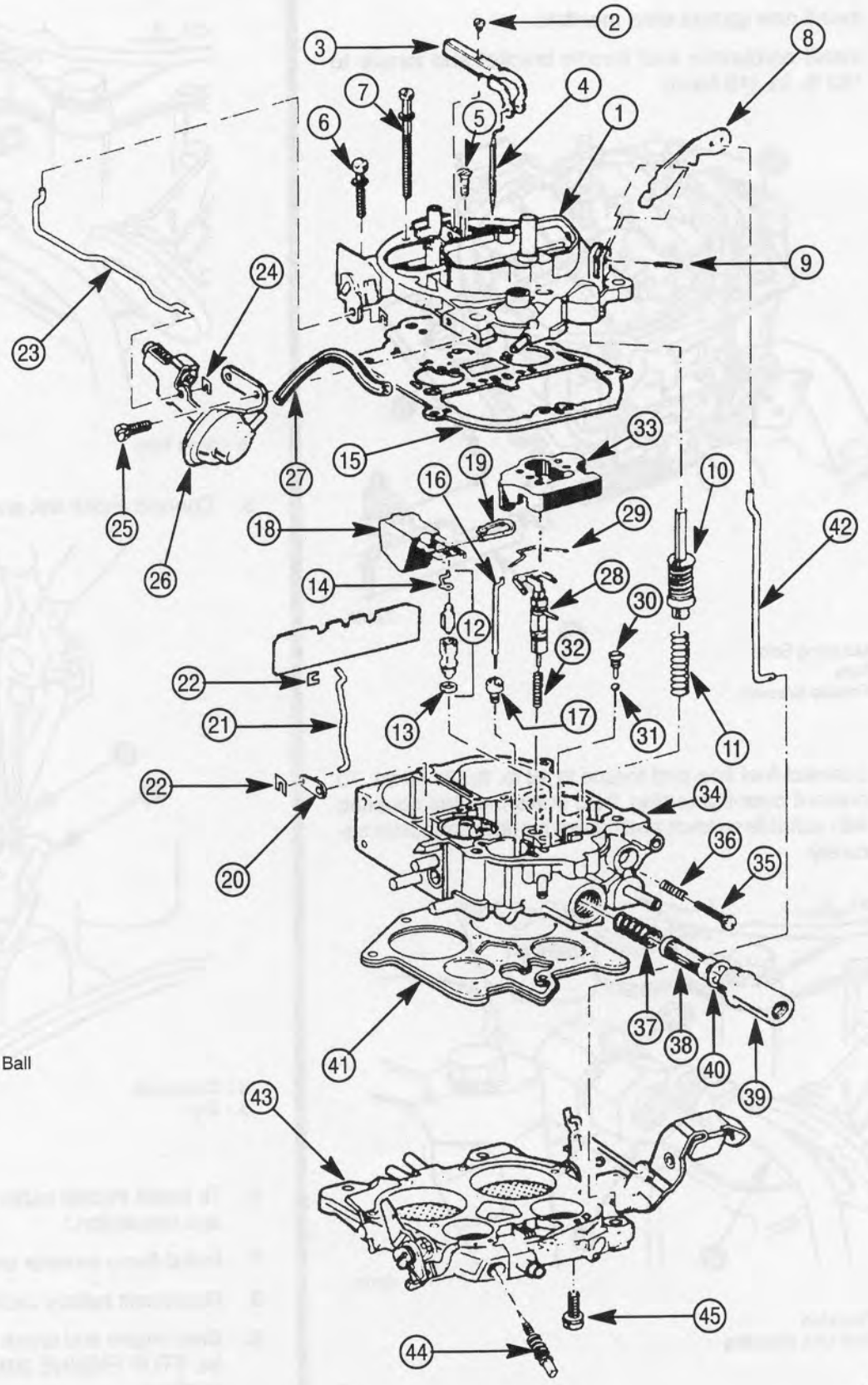
5. Connect choke link and install retaining clip.



72099

a - Choke Link
b - Clip

6. To install throttle cable refer to Section 2 - "Removal and Installation."
7. Install flame arrestor and tighten securely.
8. Reconnect battery cables to battery.
9. Start engine and check for gasoline leaks. If leaks exist, STOP ENGINE IMMEDIATELY and recheck connections.
10. Adjust idle speed and idle mixture, as previously outlined under "Adjustments."



1 - Air Horn Assembly
2 - Screw
3 - Hanger
4 - Metering Rod, Secondary
5 - Screw
6 - Screw
7 - Screw
8 - Lever
9 - Roll Pin
10 - Pump
11 - Spring
12 - Needle and Seat
13 - Gasket
14 - Pull Clip
15 - Gasket
16 - Metering Rod, Primary
17 - Jet, Primary
18 - Float Assembly
19 - Pin, Hinge - Float
20 - Lever, Intermediate Choke
21 - Rod
22 - Clip
23 - Rod
24 - Clip
25 - Screw
26 - Control
27 - Hose
28 - Power Piston
29 - Retainer, Power Piston
30 - Retainer, Pump Discharge Ball
31 - Ball, Pump Discharge
32 - Spring, Power Piston
33 - Insert, Float Bowl
34 - Float Bowl
35 - Screw, Idle Stop
36 - Spring, Idle Stop Screw
37 - Spring, Filter Nut
38 - Filter, Fuel Inlet
39 - Nut, Fuel Inlet
40 - Gasket
41 - Gasket
42 - Rod
43 - Throttle Body
44 - Idle Needle
45 - Screw

72694

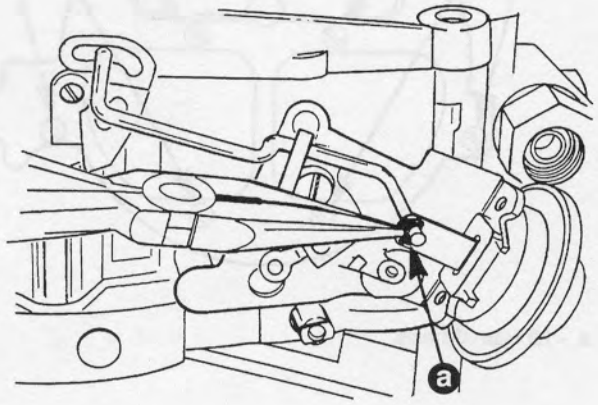
Exploded View - 4MV Quadrajet
(Rochester Carburetor)

Disassembly

IMPORTANT: Place carburetor on a holding fixture to prevent throttle valve damage.

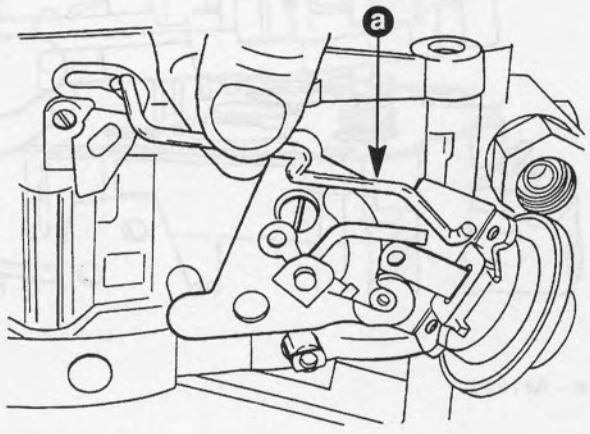
AIR HORN

1. Remove vacuum pump rod clip and rod.



72105

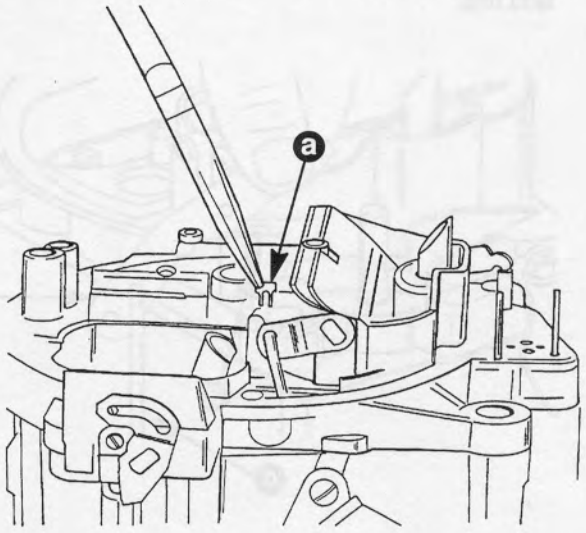
a - Rod Clip



72106

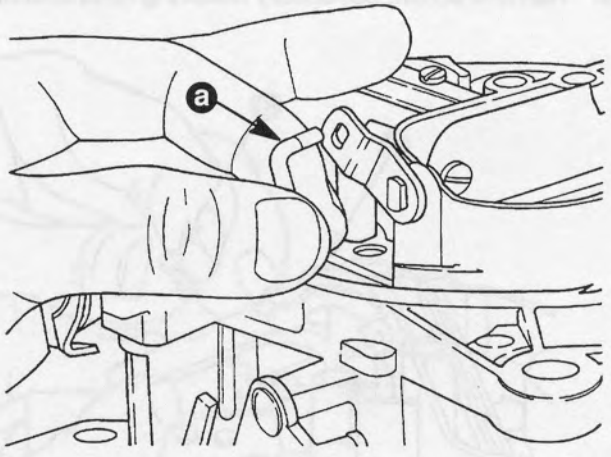
a - Rod

2. Remove choke shutter clip and rod.



72107

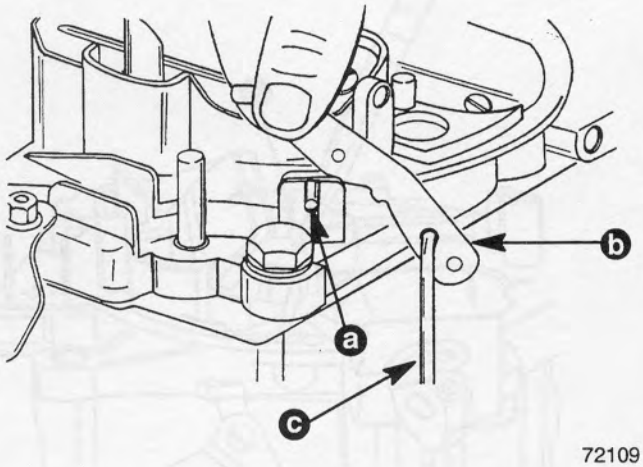
a - Clip



72108

a - Choke Shutter Rod

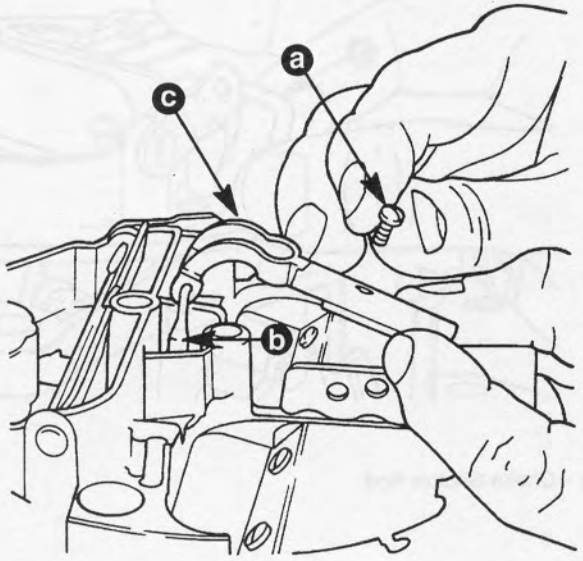
3. Drive roll pin back and remove accelerator pump lever and rod.



72109

a - Roll Pin (Not Shown)
b - Pump Lever
c - Rod

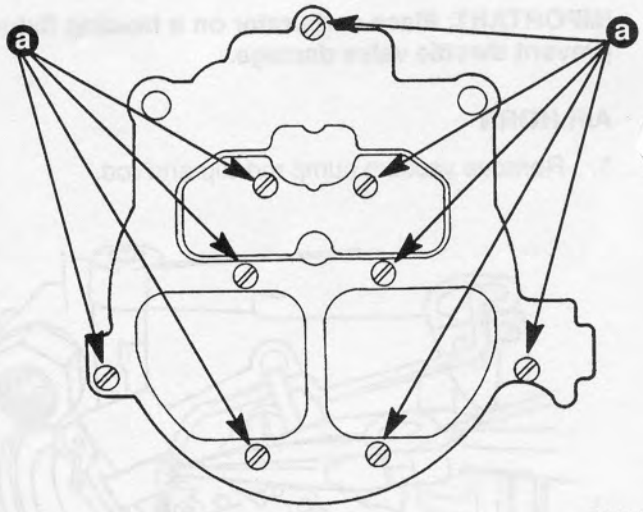
4. Remove screw, secondary metering rods and hanger.



72110

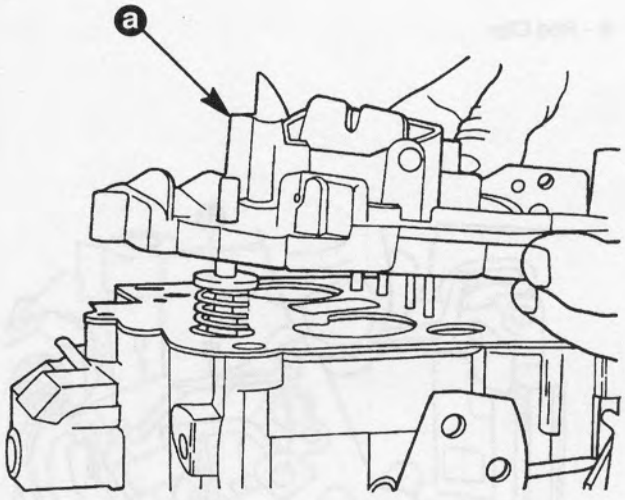
a - Screw
b - Metering Rods
c - Hanger

5. Remove air horn screws and air horn.



72111

a - Air Horn Screws

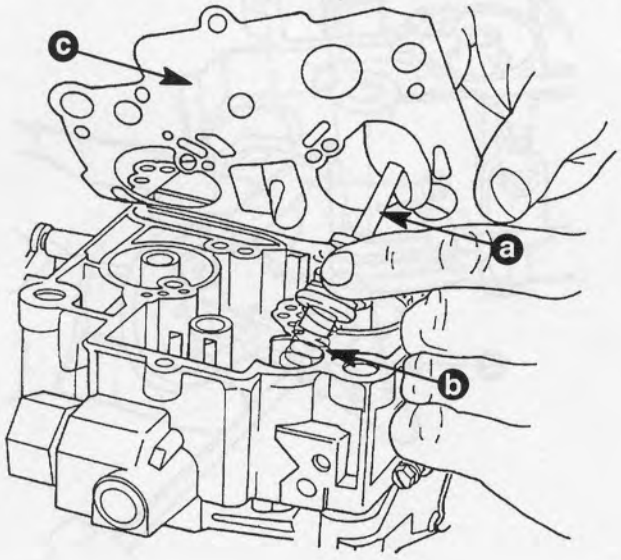


72112

a - Air Horn

FLOAT BOWL

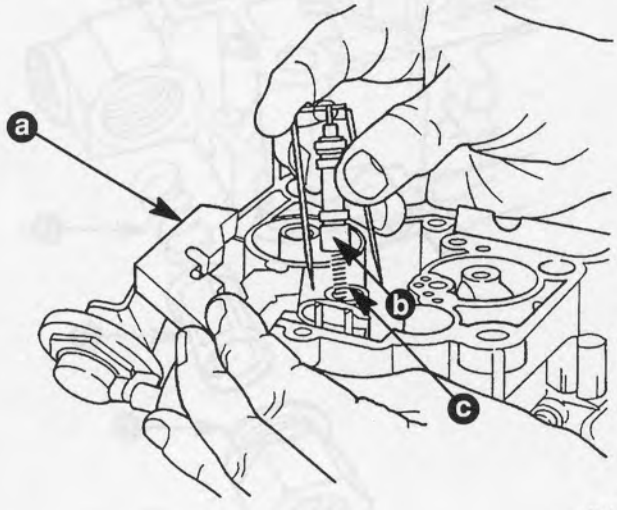
1. Remove pump plunger, return spring and gasket.



72113

a - Pump Plunger
b - Return Spring
c - Gasket

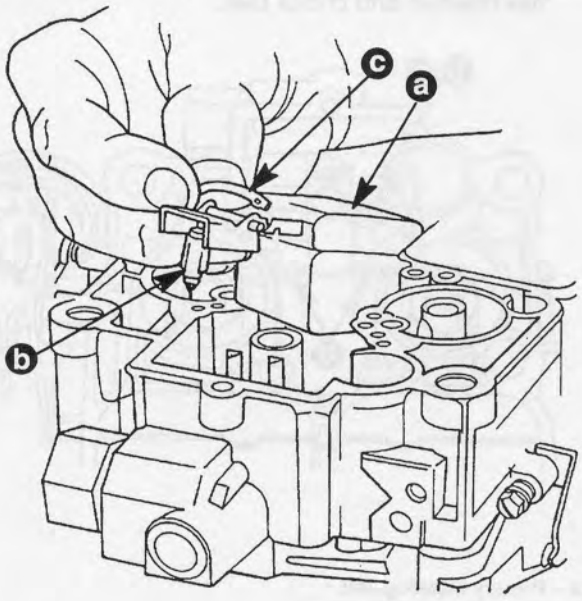
2. Remove insert block, power piston and spring.



72114

a - Insert Block
b - Power Piston
c - Spring

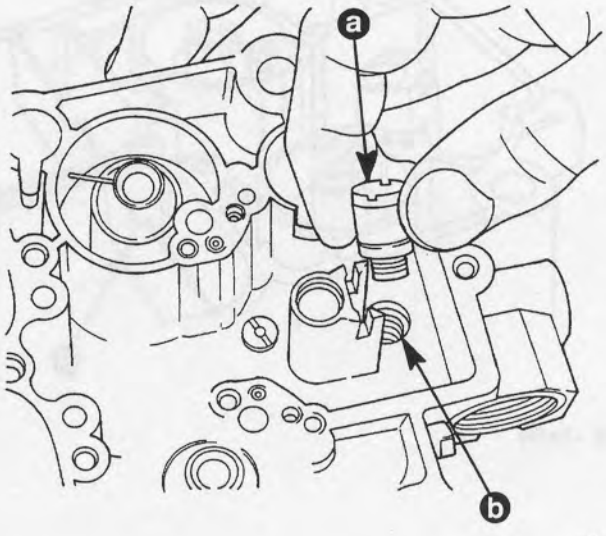
3. Remove float assembly, needle and retaining pin.



72115

a - Float Assembly
b - Needle
c - Retaining Pin

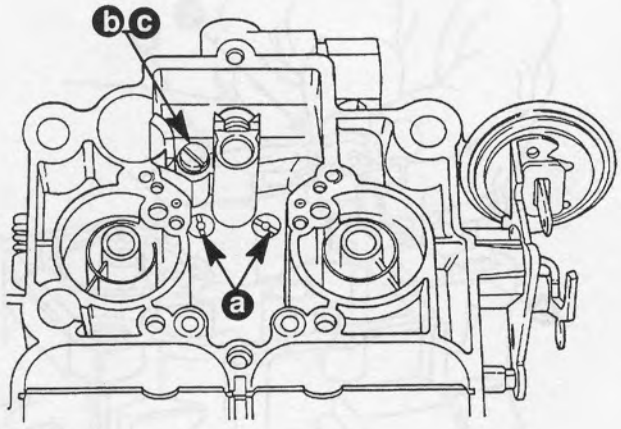
4. Remove fuel inlet seat and gasket.



72116

a - Fuel Inlet Seat
b - Gasket

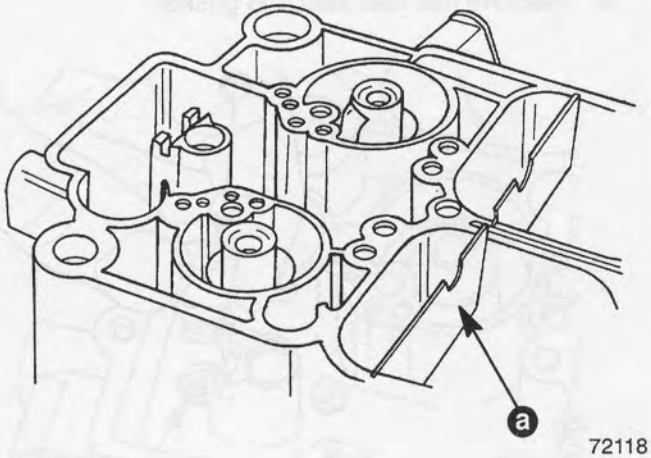
5. Remove primary metering jets, pump discharge check ball retainer and check ball.



72117

a - Primary Metering Jets
b - Pump Discharge Retainer
c - Check Ball (Not Shown)

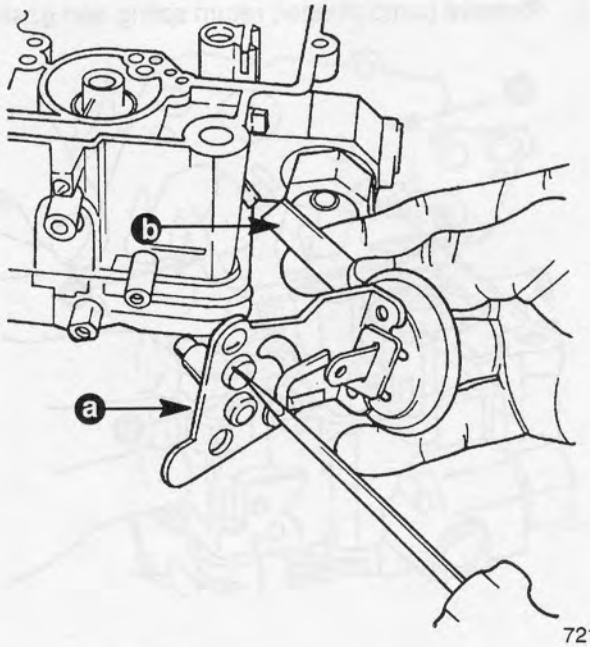
6. Remove baffle.



72118

a - Baffle

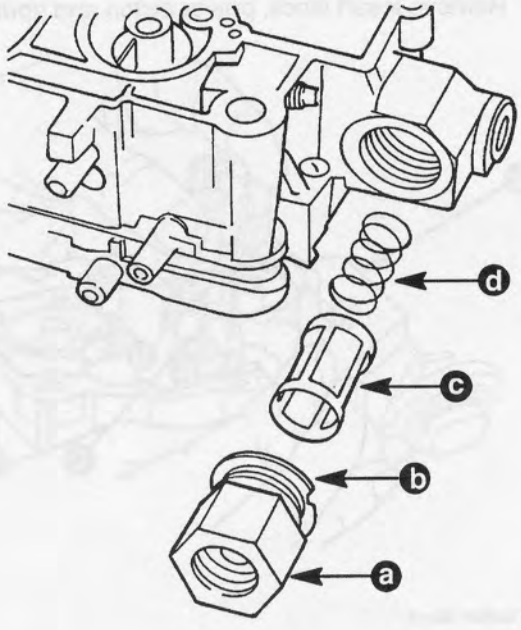
7. Remove vacuum control assembly and hose.



72119

a - Vacuum Control Assembly
b - Hose

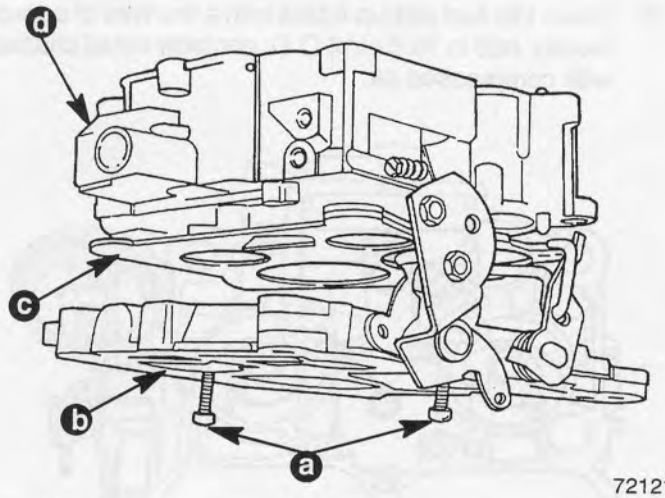
8. Remove fuel inlet filter nut, gaskets, filter and spring.



72120

a - Nut
b - Gaskets
c - Filter
d - Spring

9. Separate throttle body from float bowl and remove gasket.

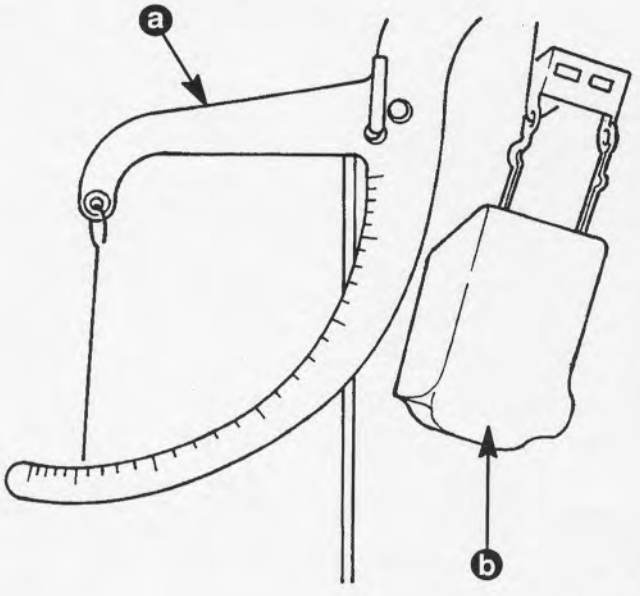


72121

a - Attaching Screws
b - Throttle Body
c - Gasket
d - Float Bowl

FLOAT WEIGHT

1. Assemble float scale to instructions with scale.
2. Check float weight to specifications.



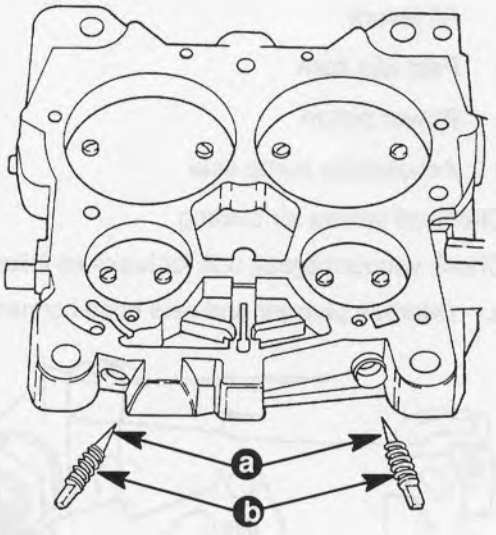
72122

a - Float Scale
b - Float

3. Replace float if it exceeds specifications.

THROTTLE BODY

1. Remove idle mixture screws and springs.



72123

a - Screw
b - Spring

IMPORTANT: Throttle body should not be disassembled any further than shown. Throttle body is serviced as an assembly.

Cleaning and Inspection

⚠CAUTION

DO NOT keep carburetor in immersion type carburetor cleaner for more than two hours.

⚠CAUTION

Rubber and plastic parts, pump plungers and diaphragm MUST NOT be immersed in carburetor cleaner. The Delrin air valve cam will withstand normal carburetor cleaner.

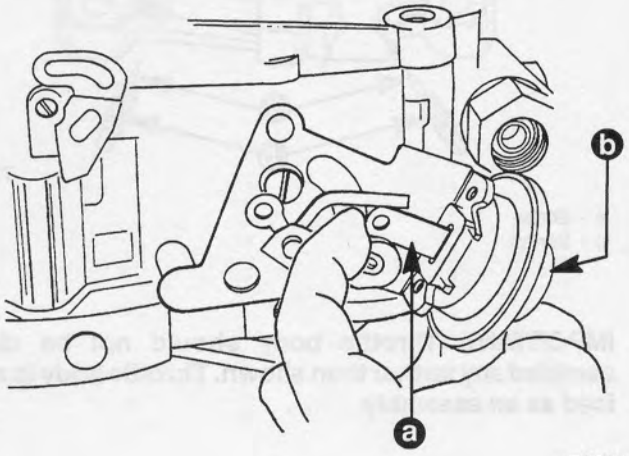
⚠WARNING

Avoid personal injury by always wearing safety goggles when using compressed air.

1. Thoroughly clean all metal parts in a commercial carburetor cleaner until all deposits have been removed. Follow cleaner manufacturer's instructions for proper cleaning and rinsing procedure. Dry parts with compressed air.
2. Using compressed air, blow out all passages in carburetor to remove any foreign material.
3. Wipe off all parts that cannot be cleaned in carburetor cleaner with a clean, dry cloth.
4. Carefully inspect all carburetor parts for wear and damage; pay particular attention to the following:
   - Idle mixture needles

- Float needle and seat
- Casting surfaces
- All levers
- Fast idle cam
- Power piston
- Accelerator pump seal

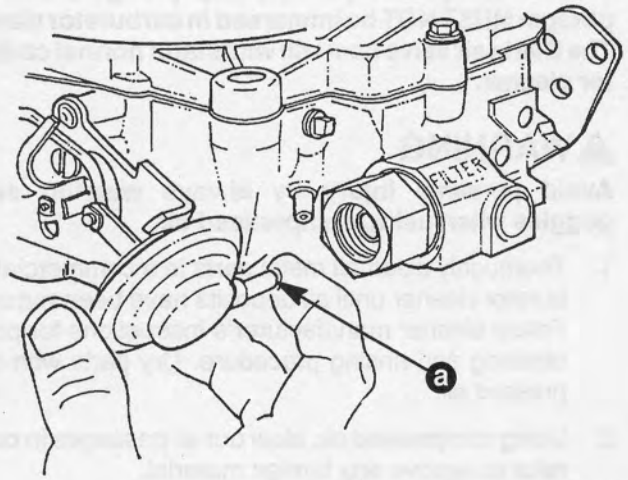
5. Check all valves for binding.
6. Check vacuum break unit for leaks as follows:
   a. Depress plunger and seal hose connection.



72124

a - Plunger
b - Hose Connection (Hidden in This View)

   b. Maintain seal on hose connection; plunger must remain seated. If plunger extends, replace unit.

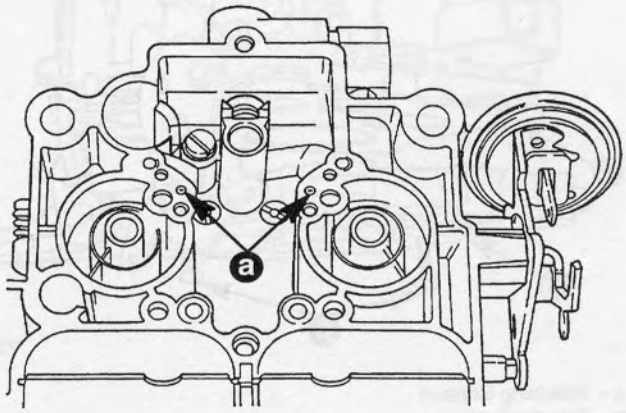


72125

a - Hose Connection

IMPORTANT: The idle fuel pickup tubes have a smaller I.D. at the bottom than the top. Do not drill.

7. Clean idle fuel pickup tubes with a fine wire of approximately .020 in. (0.5 mm) O.D. and blow out all channels with compressed air.



72117

a - Idle Fuel Pickup Tubes

Reassembly

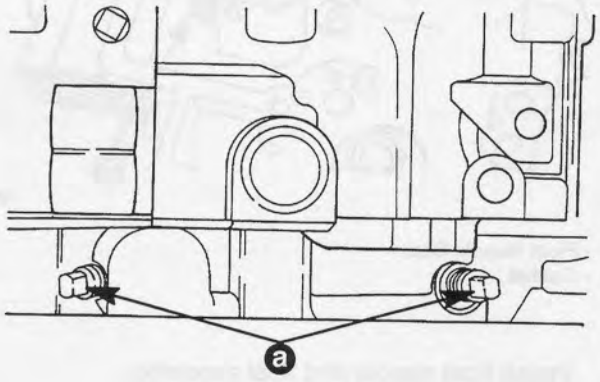
THROTTLE BODY

NOTICE

Refer to "Adjustments" for all adjustment procedures.

IMPORTANT: Seat idle mixture screws lightly or damage to needles and seats will result.

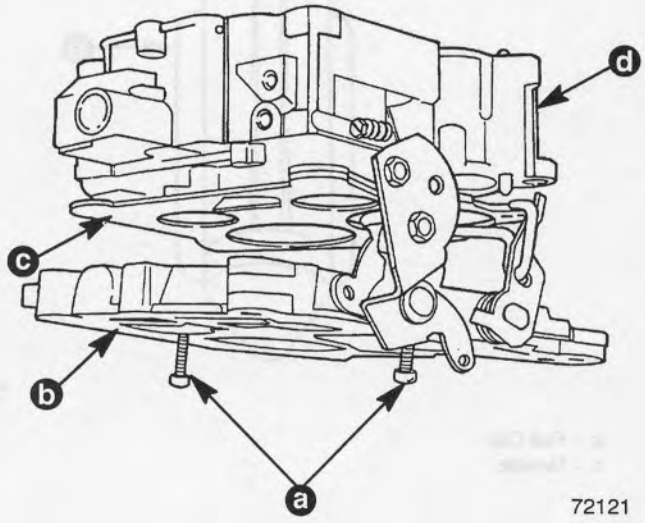
1. Install idle mixture needles and springs until lightly seated, then back out 2 to 3 turns.



72098

a - Idle Mixture Needles and Springs

2. Install new gasket and assemble throttle body to float bowl. Tighten securely.



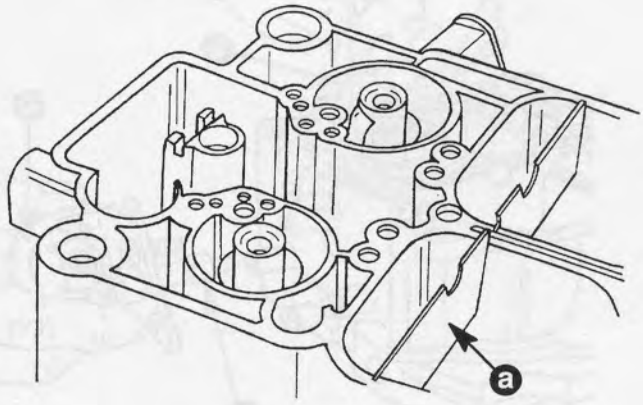
72121

a - Attaching Screws
b - Throttle Body
c - Gasket
d - Float Bowl

FLOAT BOWL

IMPORTANT: Place carburetor on a holding fixture to prevent damage to throttle valve.

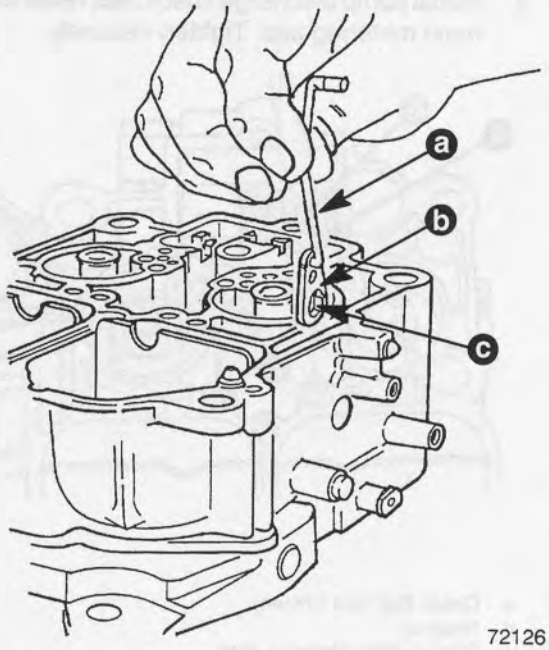
1. Install baffle plate.



72118

a - Baffle Plate

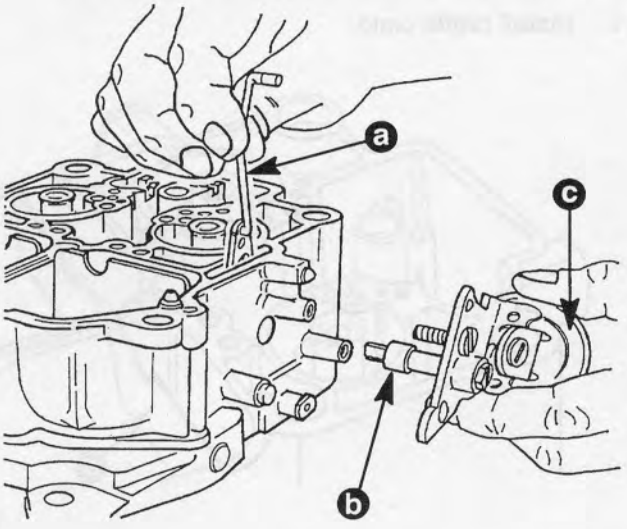
2. Install intermediate choke lever and vacuum break control bracket assembly.
   a. Using choke rod, suspend intermediate choke lever in float bowl cavity so that flat sided hole aligns with hole in side of float bowl.



72126

a - Choke Rod
b - Choke Lever
c - Flat Sided Hole

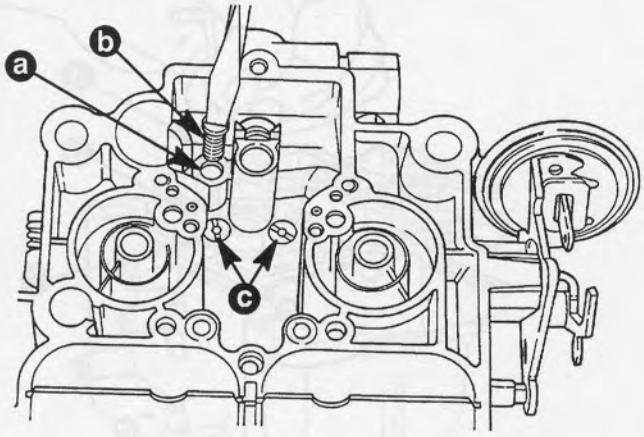
b. Insert choke shaft on vacuum break control assembly to engage flat sided hole of choke lever, and secure with screw. Tighten securely.



72127

a - Choke Rod
b - Choke Shaft
c - Vacuum Break Control Assembly

3. Install pump discharge check ball, retainer and primary main metering jets. Tighten securely.

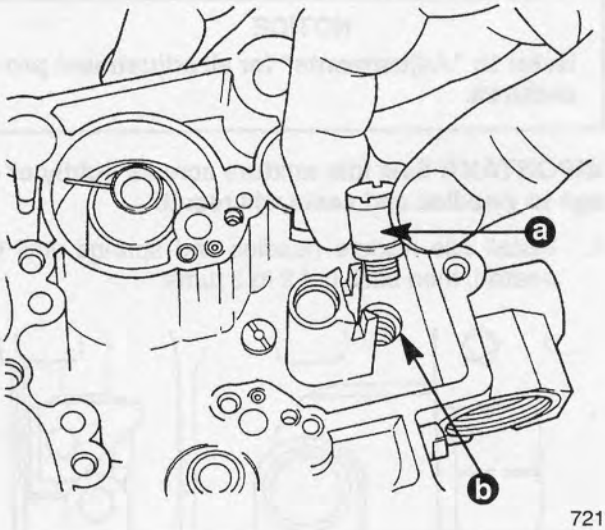


72128

a - Check Ball (Not Shown)
b - Retainer
c - Primary Main Metering Jets

IMPORTANT: Float needle and seat should be replaced as a set only.

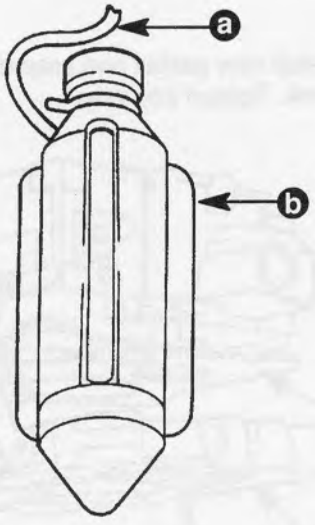
4. Install float needle seat and gasket.



72116

a - Float Needle Seat
b - Gasket

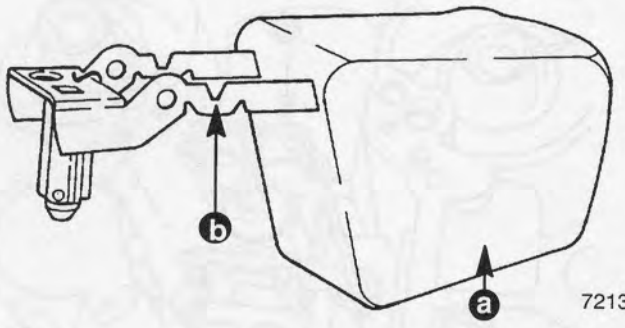
5. Install float needle and float assembly.
   a. Install pull clip onto needle.



72129

a - Pull Clip
b - Needle

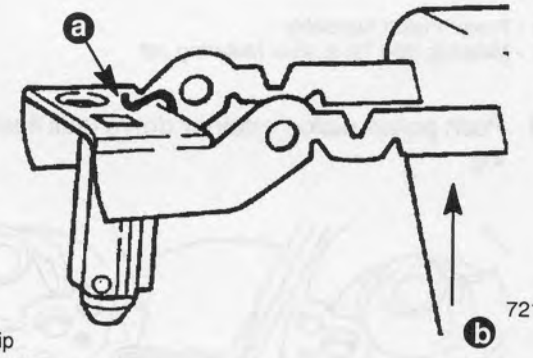
b. If a new float or needle and seat are used, bend float arm slightly upward at notch for easier adjustment.



72130

a - Float
b - Float Arm Notch

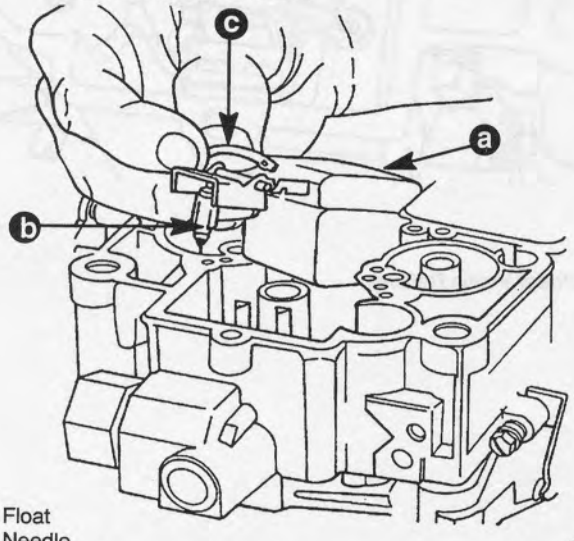
c. Hook needle pull clip over edge of float arm closest to pontoon.



72130

a - Pull Clip
b - Float Arm

d. Install retaining pin into float arm and install float and needle into bowl.

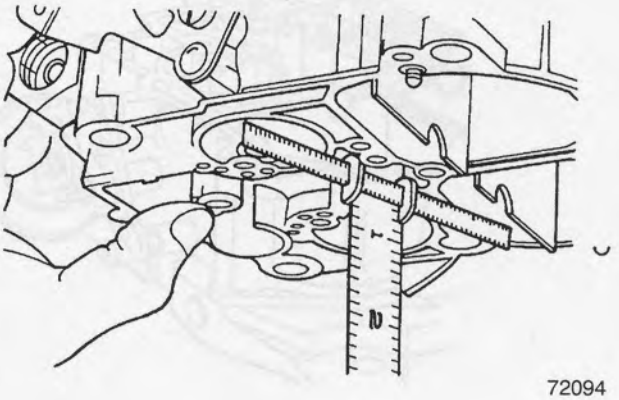


a - Float
b - Needle
c - Retaining Pin

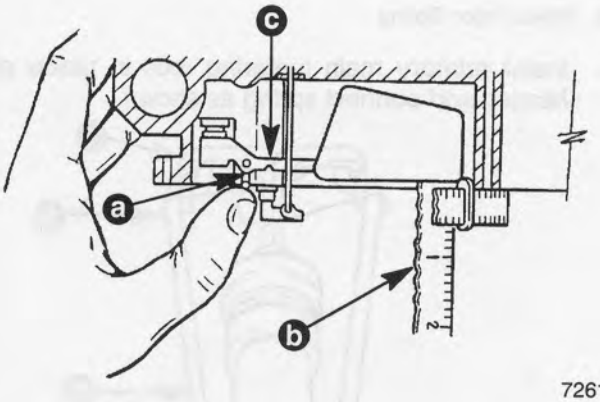
72115

IMPORTANT: Top of retaining pin must extend above casting by .010 in. (0.254 mm) for good pin retention.

6. If float requires adjustment hold hinge pin firmly, turn carburetor upside down and measure from casting surface to toe of float with universal carburetor gauge. Check specifications.
7. Bend at float arm notch for adjustment to specifications.



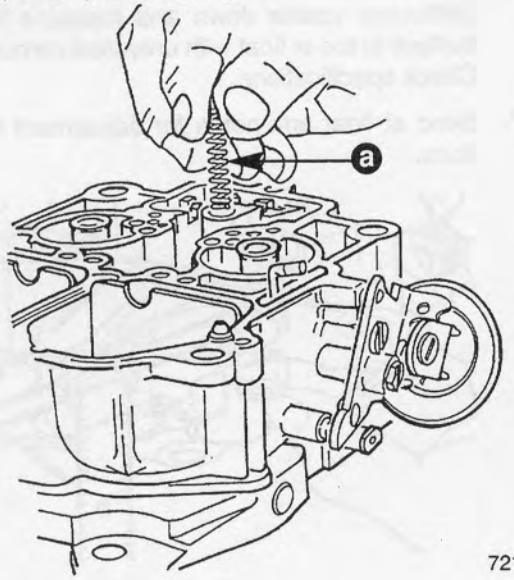
72094



72610

a - Hinge Pin
b - Universal Carburetor Gauge (P/N 91-36392)
c - Notch - Bend Here

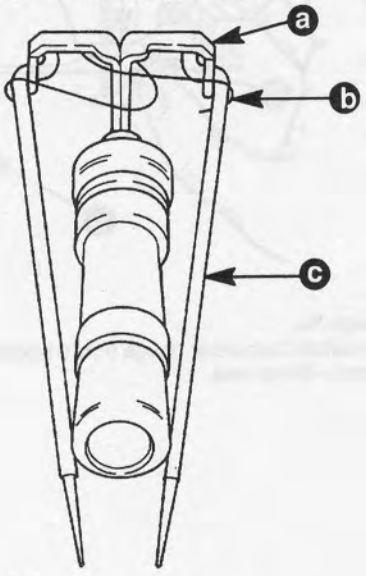
8. Install power piston spring.



72131

a - Power Piston Spring

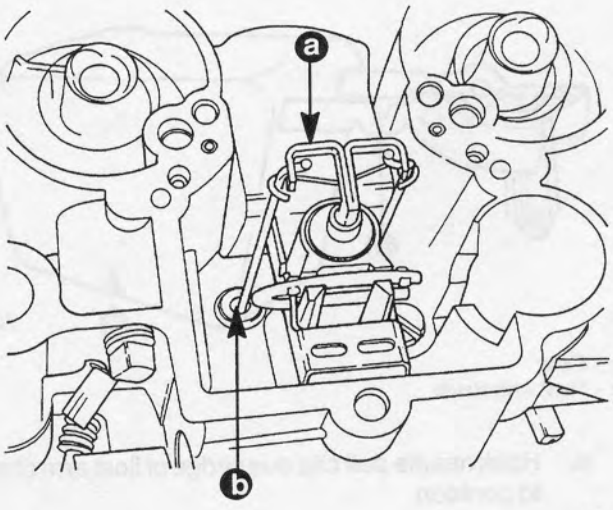
9. Install primary main metering rods in power piston hanger, and connect spring as shown.



72132

a - Power Piston Hanger
b - Tension Spring
c - Metering Rods

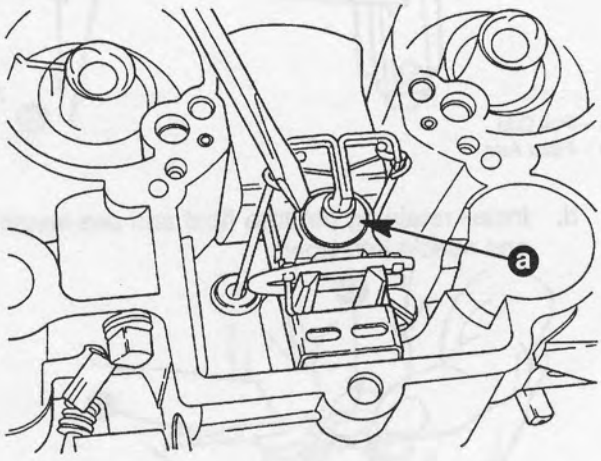
10. Install power piston assembly, guiding metering rod tips into main metering jets.



72133

a - Power Piston Assembly
b - Metering Rod Tip in Main Metering Jet

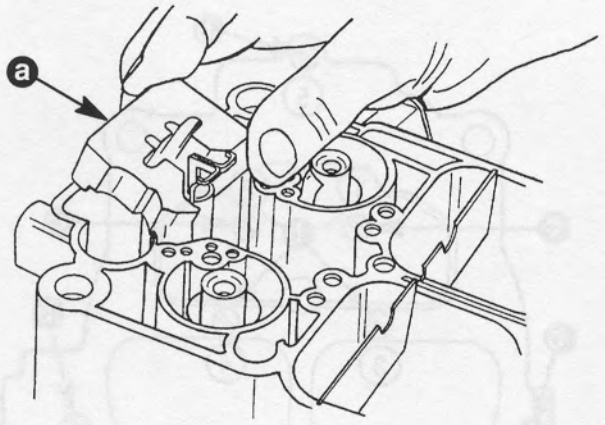
11. Push power piston retainer down until flush with casting.



72134

a - Power Piston Retainer

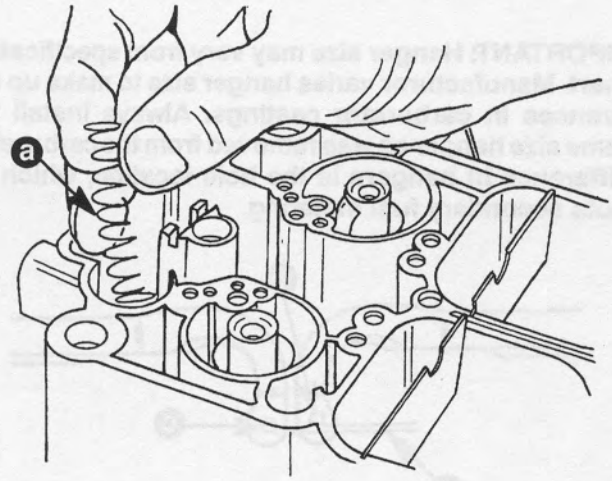
12. Install filler block.



72135

a - Filler Block

13. Install accelerator pump plunger spring.

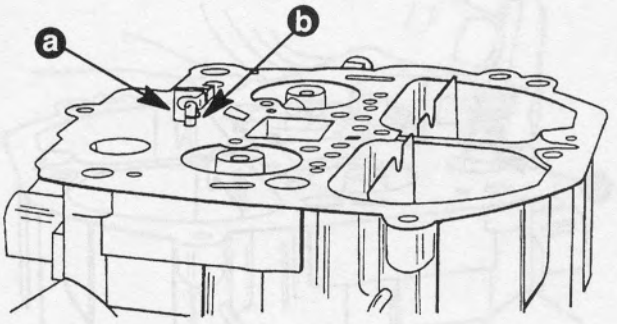


72136

a - Spring

AIR HORN

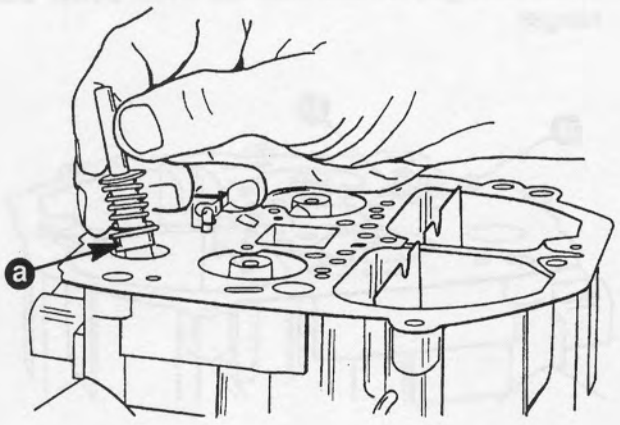
1. Install new gasket and slide tab under power piston hanger.



72137

a - Power Piston Hanger
b - Gasket Tab

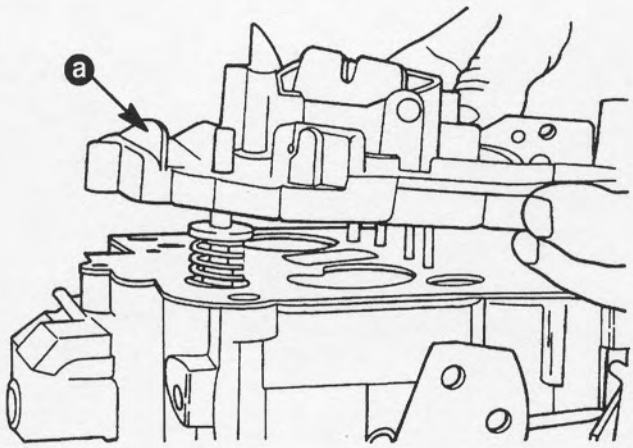
2. Install accelerator pump plunger.



72138

a - Plunger

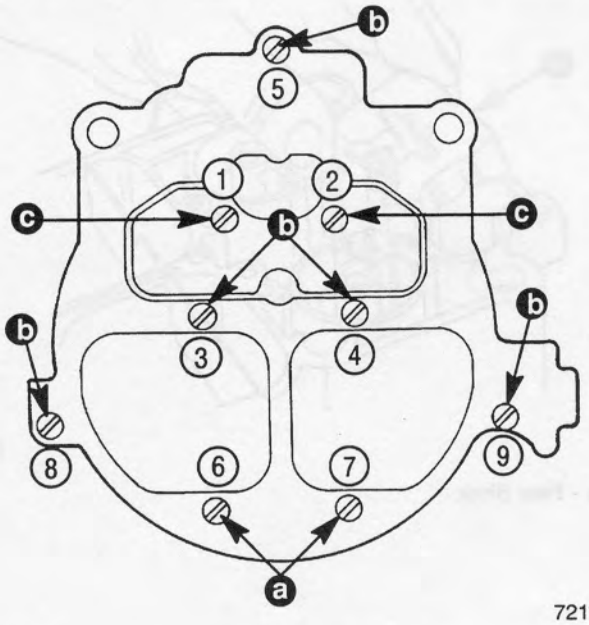
3. Install air horn.



72112

a - Air Horn

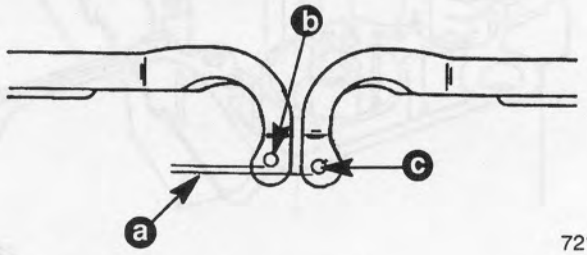
4. Install nine attaching screws. Tighten securely in sequence as numbered.



72111

a - Long
b - Short
c - Countersunk

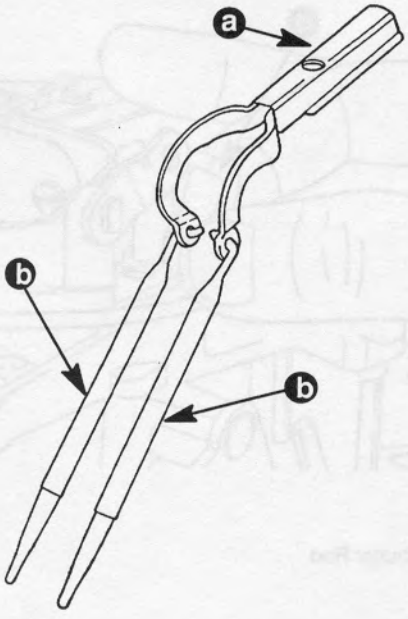
IMPORTANT: Hanger size may vary from specification chart. Manufacturer varies hanger size to make up differences in carburetor castings. Always install the same size hanger as was removed from the carburetor. Difference in hangers is the hole location, which affects secondary fuel metering.



72139

a - Hole Location Changes Fuel Metering
b - Richer
c - Leaner

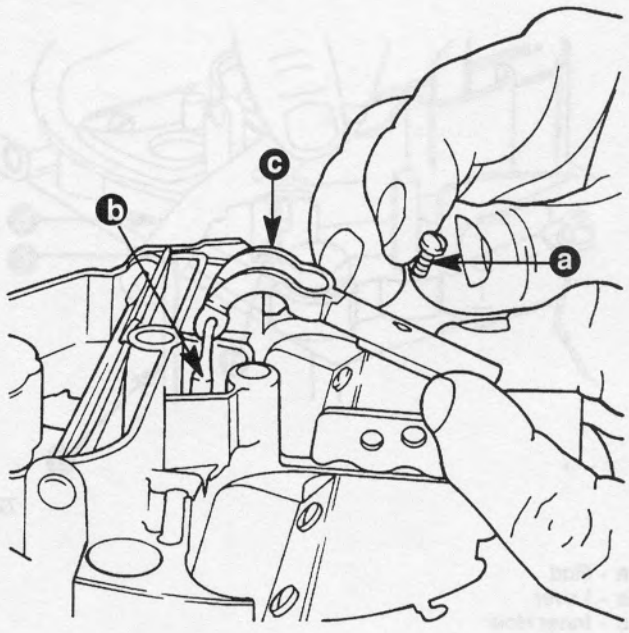
5. Install secondary metering rods into hanger with upper ends toward each other as shown.



72140

a - Hanger
b - Metering Rods

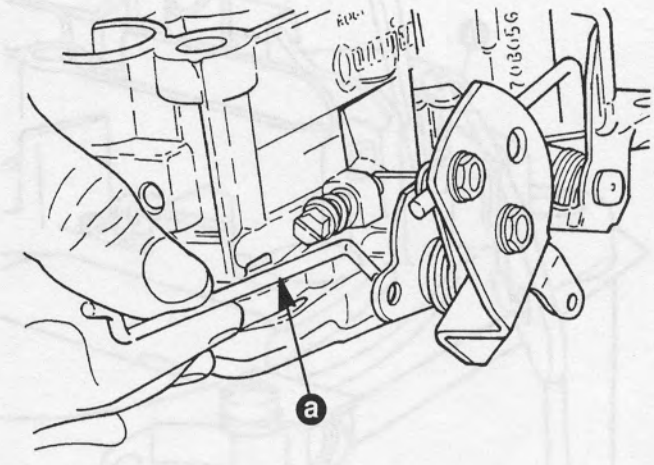
6. Install metering rods and hanger and secure with screw. Tighten securely.



72110

a - Screw
b - Metering Rods
c - Hanger

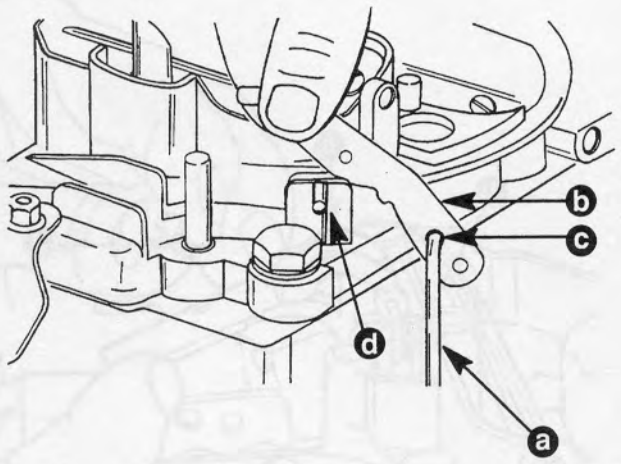
7. Install pump lever rod.



72080

a - Pump Lever Rod

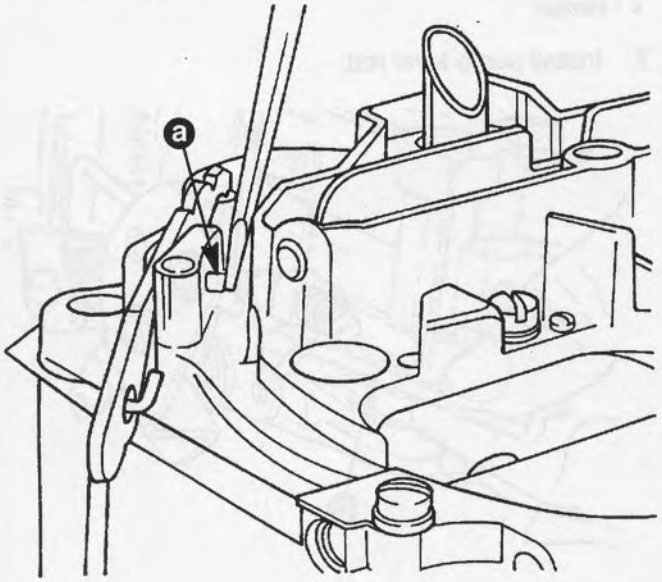
8. Install rod into lever inner hole and place lever into casting mount.



72109

a - Rod
b - Lever
c - Inner Hole
d - Casting Mount

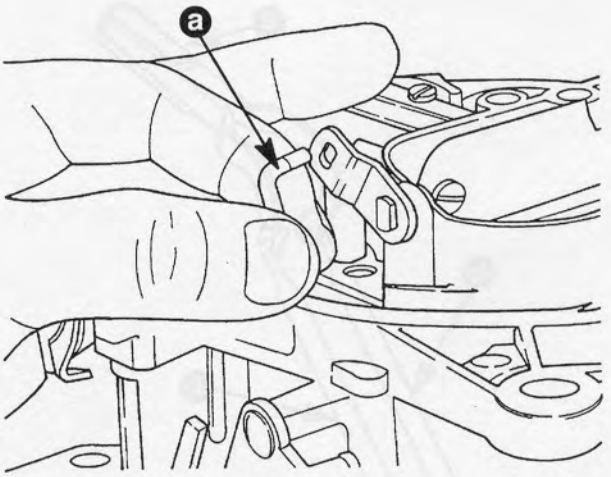
9. Press roll pin into place using a screwdriver.



72141

a - Roll Pin

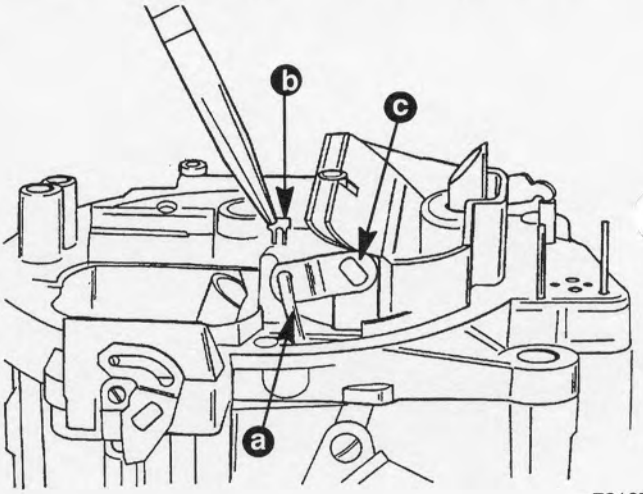
10. Install bottom end of choke shutter rod into intermediate choke lever in float bowl.



72108

a - Choke Shutter Rod

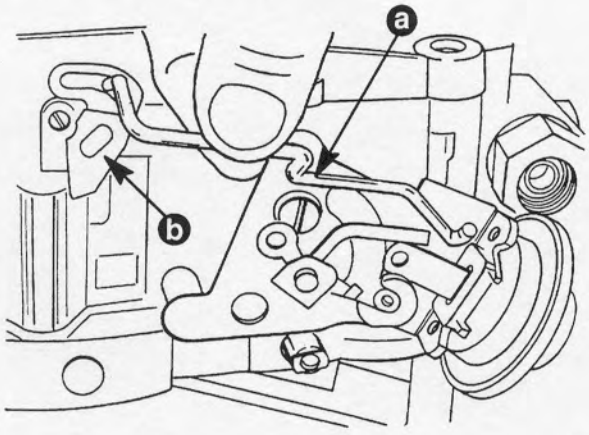
11. Install upper end of choke shutter rod into the choke blade lever; install clip onto choke shutter rod.



72107

a - Choke Shutter Rod
b - Clip
c - Choke Blade Lever

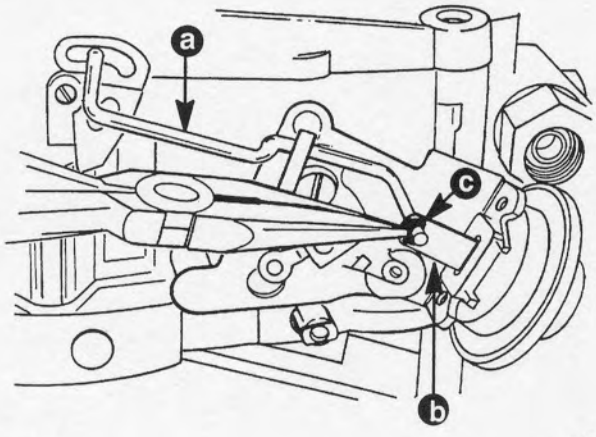
12. Install rod into air valve lever.



72106

a - Rod
b - Air Valve Lever

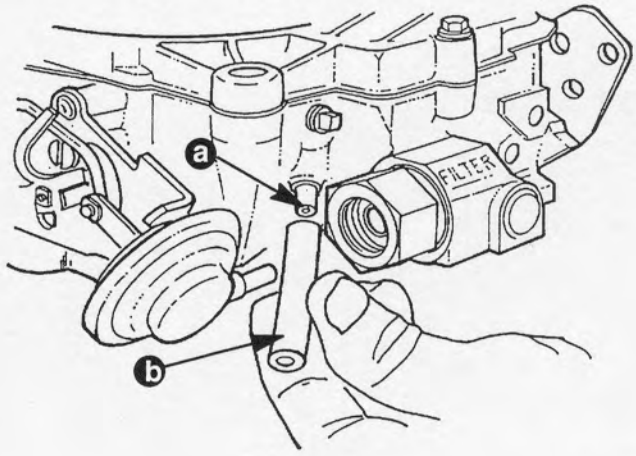
13. Install rod into vacuum break arm and install clip.



72105

a - Rod
b - Vacuum Break Arm
c - Clip

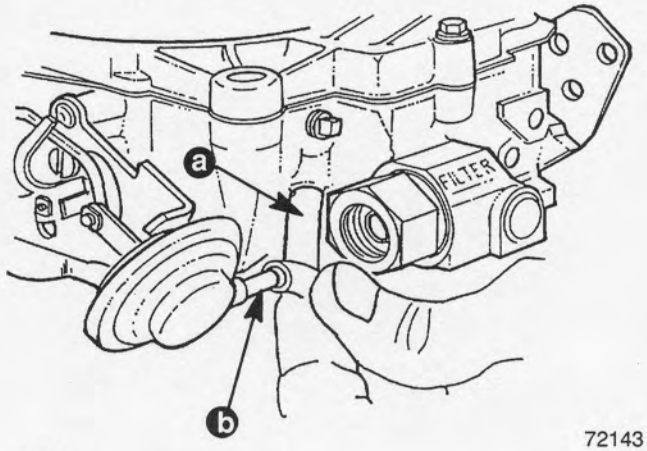
14. Install vacuum break hose on carburetor fitting.



72142

a - Fitting
b - Hose

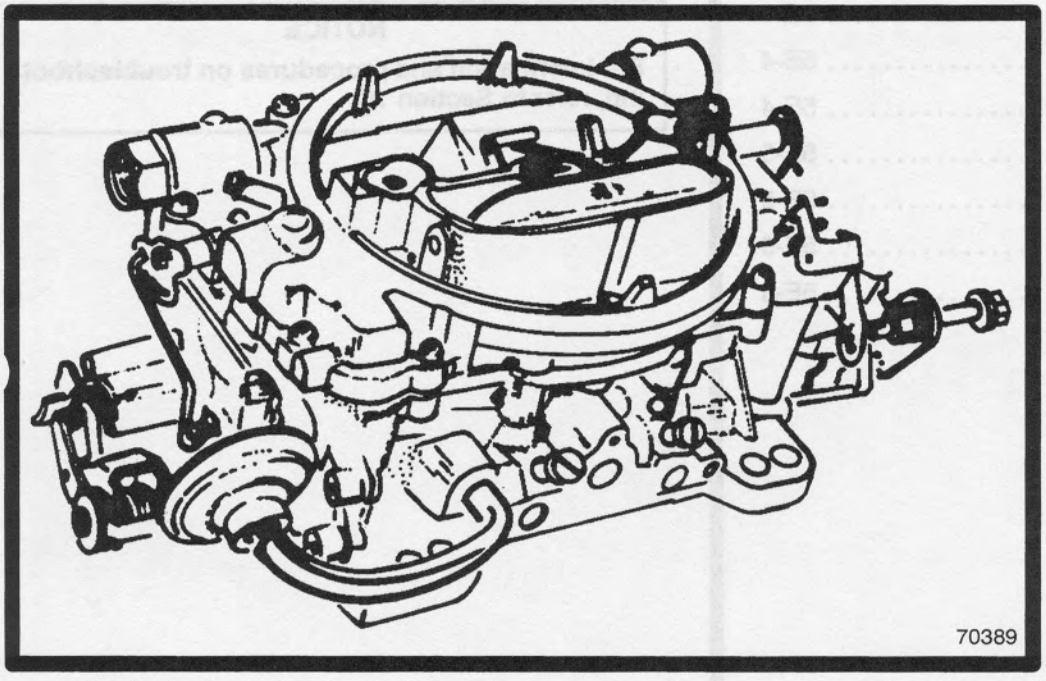
15. Install vacuum break hose on vacuum dashpot fitting.



72143

a - Hose
b - Dashpot Fitting

FUEL SYSTEM



WEBER 4 BARREL CARBURETOR

5

E

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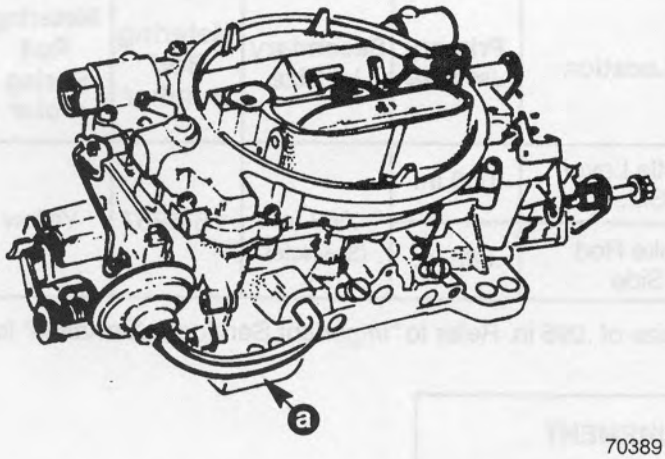
NOTICE

For information and procedures on troubleshooting, refer to Section 1C.

Identification



70389

a - Weber Identification Number Location

Replacement Parts Warning

⚠ WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Torque Specifications

Fastener Location	lb. ft.	N·m
Carburetor to Manifold	12	16
Fuel Line to Carburetor	18	24

Tools

Part Number	Description
91-36392	Universal Carburetor Gauge
91-59339	Tachometer
Obtain Locally	Universal Carburetor Stand
	TORX® Screwdrivers (15, 20, 25)

TORX® SCREWDRIVERS

Weber carburetors will have a "star" shaped socket in the head of some screws. A TORX® screwdriver must be used on this type of screw. The sizes used are numbers 15, 20 and 25.

MCM Carburetor Specifications

Engine Model	Carb Type	Mercury Number (Manufacturer Number)	Jet Location	Primary Jet Size	Secondary Jet Size	Metering Rod Number	Metering Rod Spring Color
MCM 4.3LX Alpha	Weber WFB	3304-9565A6 (9600)	Throttle Lever Side	.089 In.	.089 In. (See Note)	16-6857	Yellow
			Choke Rod Side	.089 In.			

NOTE: Some early production engines had stock secondary jet size of .095 in. Refer to "Important Service Information" for more information.

UNIT OF MEASUREMENT

In. (mm)

All measurements are ± 1/64 in. (0.4 mm).

MCM Carburetor Adjustment Specifications

Engine Model	MCM 4.3LX
Make and Model	Weber WFB
Carb Manufacturer Number	9600
Float Level	1-9/32 In. (33 mm)
Float Drop	2 In. (51 mm)
Pump Rod Hole Location	#3 from End
Accelerator Pump	7/16 In. (11 mm) (NOTE 1)
Choke Pull-Off	1/8 In. (3.5 mm)
Choke Coil Rod	Top of Rod Even with Bottom of Lever Hole (NOTE 2)

NOTE 1: Measured from top of carburetor to bottom of S-link.
NOTE 2: Remove choke rod from lever hole. Choke held closed and choke rod pushed down with top edge of rod even with bottom edge of hole.

Description

Weber WFB carburetor is unique in design, as the main body and flange are cast as a one piece unit. This, along with the bowl cover, make up the two piece construction which is made of light, durable aluminum to dissipate heat.

There are two separate float circuits. Each float circuit supplies fuel to a primary low speed circuit and a primary and secondary high speed circuit. The bowls are vented to the inside of the air horn. A connecting vent passage effects a balance of the air pressure between the two bowls.

The float needle valves are installed at an angle to provide the best possible seating action on the needles. This provides better needle response to float movement, also.

The high speed circuits use staged step-up rods in the main metering jets to control the amount of fuel admitted to the nozzles. The position of the step-up rod is controlled by manifold vacuum applied to the vacuum piston.

A primary air bleed located in the venturi cluster prevents a rich condition or bog as the high speed circuit is reactivated after deceleration.

Small "L" shaped metal tabs, called "distribution tab(s)," are attached to some venturi clusters and protrude into the air stream at the proper location to aid distribution of fuel on selected applications.

Precautions

⚠ WARNING

Always disconnect battery cables from battery BEFORE working on fuel system to prevent fire or explosion.

⚠ WARNING

Be careful when cleaning flame arrestor and crankcase ventilation hose: gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is OFF. DO NOT smoke or allow sources of spark or open flame in area when cleaning flame arrestor and crankcase ventilation hose.

⚠ WARNING

Be careful when changing fuel system components: gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is OFF. DO NOT smoke or allow sources of spark or open flame in area while changing fuel filter. Wipe up any spilled fuel immediately.

⚠ WARNING

Make sure no fuel leaks exist, before closing engine hatch.

⚠ CAUTION

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing or water pickup inlet, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

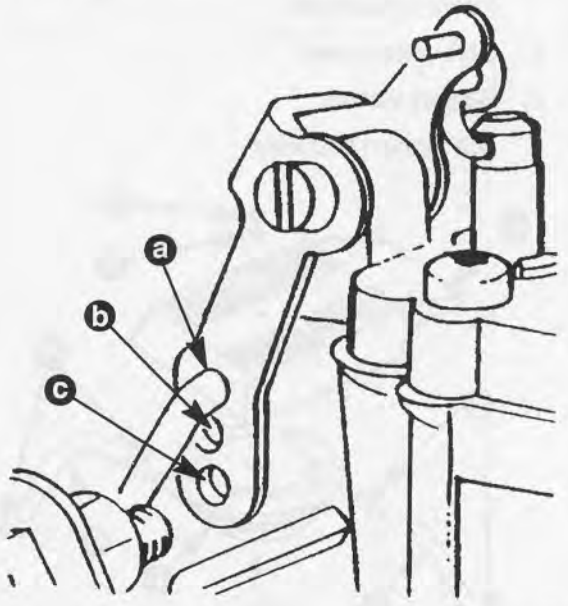
Important Service Information

Richness at Wide-Open-Throttle

If you receive a complaint of a Weber carburetor running rich at wide-open-throttle, the problem may be cured by changing the secondary metering jet size from .095 in. to .089 in. Refer to the appropriate instructions in this section for removal and installation of secondary metering jets.

Adjustable Accelerator Pump

The accelerator pump lever on Weber Carburetors has three holes in it. The closest hole to the lever's pivot point is the richest, the second hole is leaner and the hole furthest away is the leanest. All production carburetors have the pump rod installed in the closest (richest) hole. If you are having a "rich" bog on acceleration, move the rod to the second or third hole. Weber put the three holes in the lever so the amount of fuel delivered by the accelerator pump could be changed.



70472

a - Richest
b - Leaner
c - Leanest

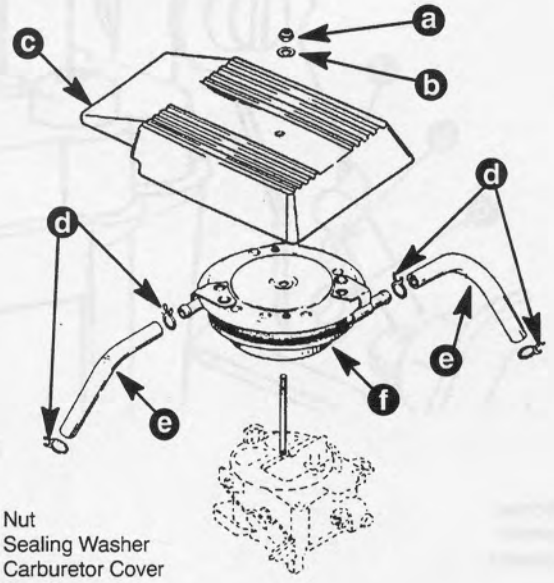
Maintenance

Flame Arrestor

NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

1. Remove (in the following order):
   a. Nut
   b. Sealing washer
   c. Carburetor cover
   d. Crankcase ventilation hoses from flame arrestor and rocker arm covers
   e. Flame arrestor
2. Clean and inspect:
   a. Clean flame arrestor in solvent and blow dry with compressed air.
   b. Clean crankcase ventilation hoses.
   c. Inspect crankcase ventilation hoses for cracks or deterioration, and replace if necessary.
3. Install (in the following order):
   a. Flame arrestor
   b. Crankcase ventilation hoses to flame arrestor and rocker arm covers
   c. Carburetor cover
   d. Sealing washer
   e. Nut (tighten securely)



a - Nut
b - Sealing Washer
c - Carburetor Cover
d - Sta-Strap
e - Crankcase Ventilation Hose(s)
f - Flame Arrestor

71372

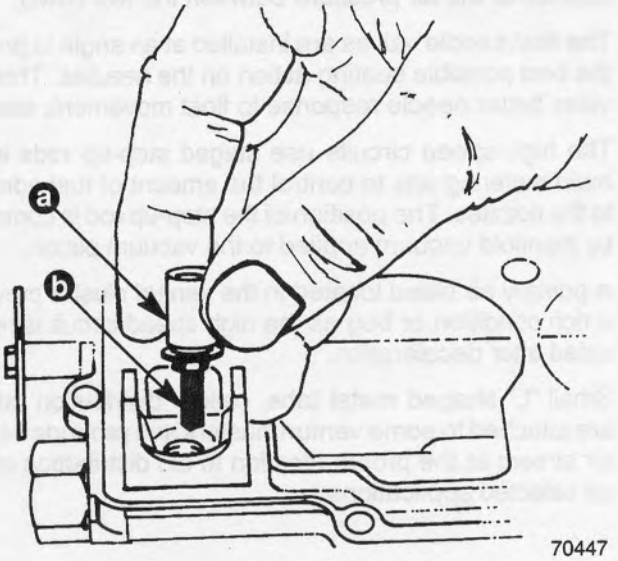
Flame Arrestor with Carburetor Cover (Typical)

Fuel Filter

NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

Carburetor inlet fuel filter is installed in bottom side of fuel inlet seat (in the carburetor top). Refer to "Disassembly" and "Reassembly" to service.



70447

a - Fuel Inlet Seat (with Gasket)
b - Fuel Inlet Filter

Adjustments

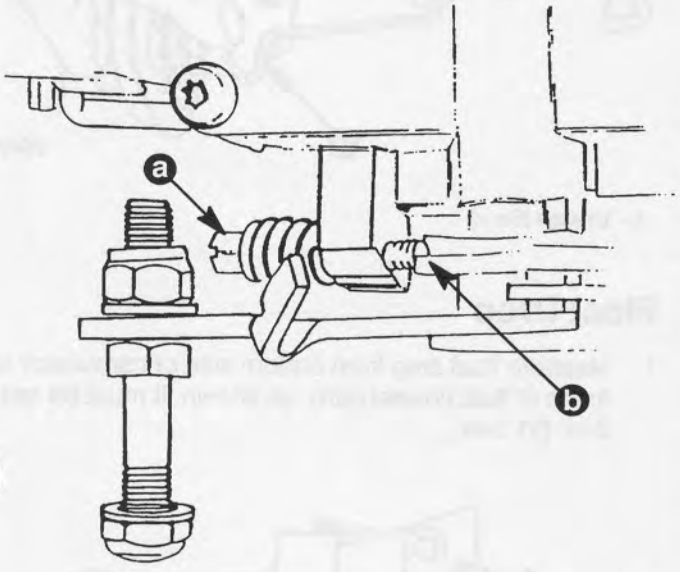
NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

Accelerator Pump

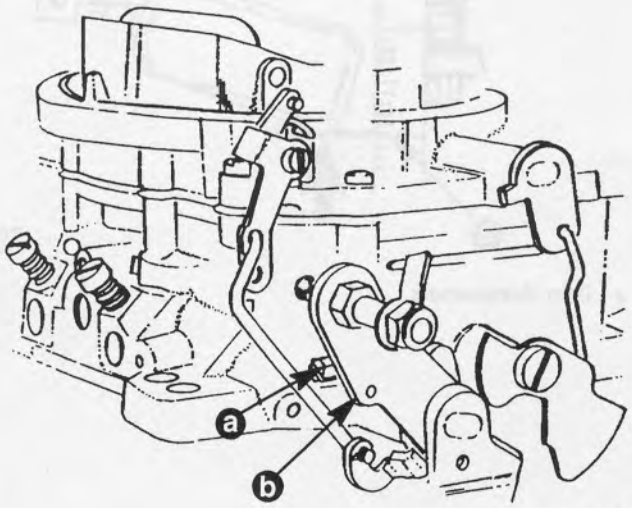
IMPORTANT: Refer to "Important Service Information" in this section, regarding the three accelerator pump linkage holes and placement of linkage rod.

1. Back out idle speed screw until it no longer contacts throttle lever.



70474

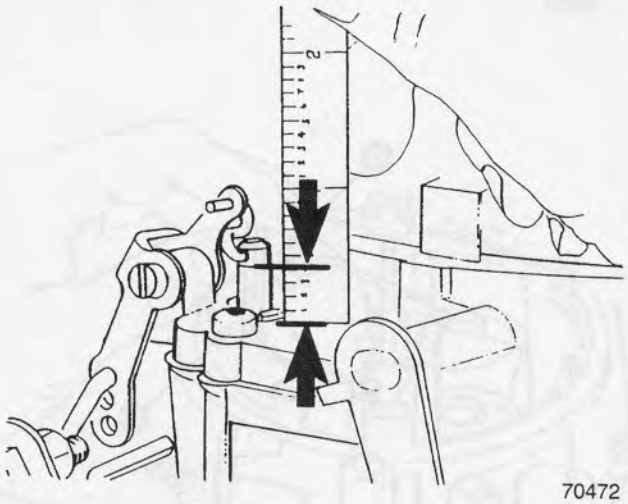
a - Idle Speed Screw
b - Throttle Lever Contact Point



70473

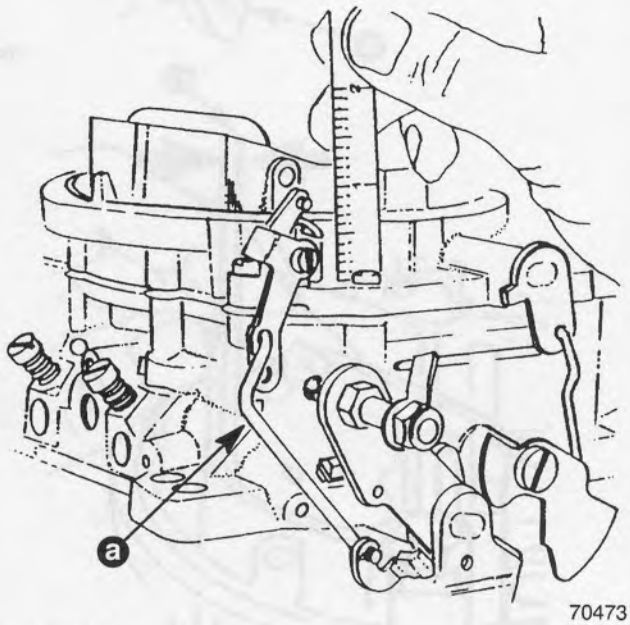
a - Idle Speed Screw
b - Throttle Lever

2. Close throttle valves completely.
3. Accelerator pump is set at 7/16 in. (11 mm), which is measured from the carburetor top to the bottom of the S-link as shown.



70472

4. Adjustment of accelerator pump is done by bending the linkage as necessary to achieve the proper dimension as stated above.

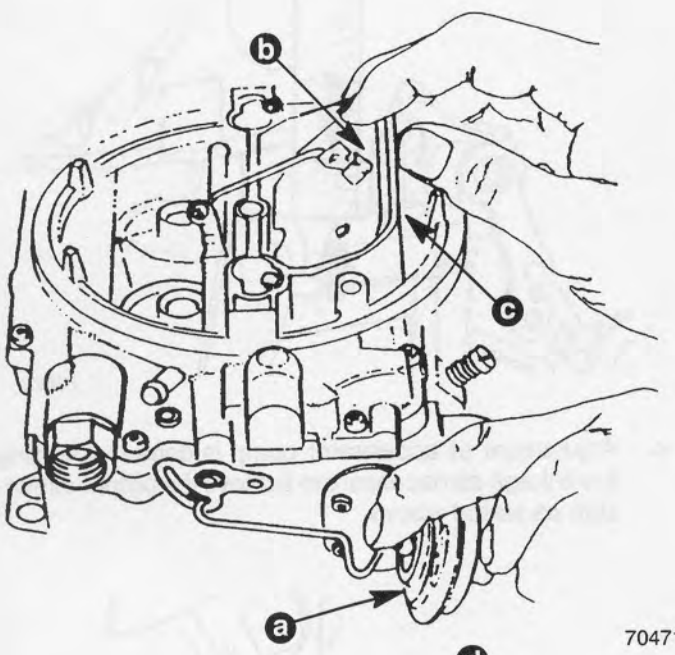


70473

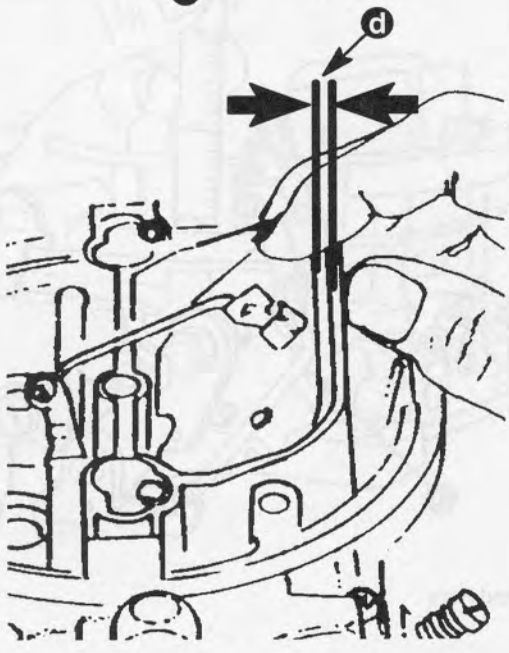
a - Bend Here

Choke Pull-Off

1. Choke pull-off is checked by holding in on vacuum diaphragm and attempting to close choke plate. The gap between the plate and housing is to be set at 1/8 in. (3.5 mm).



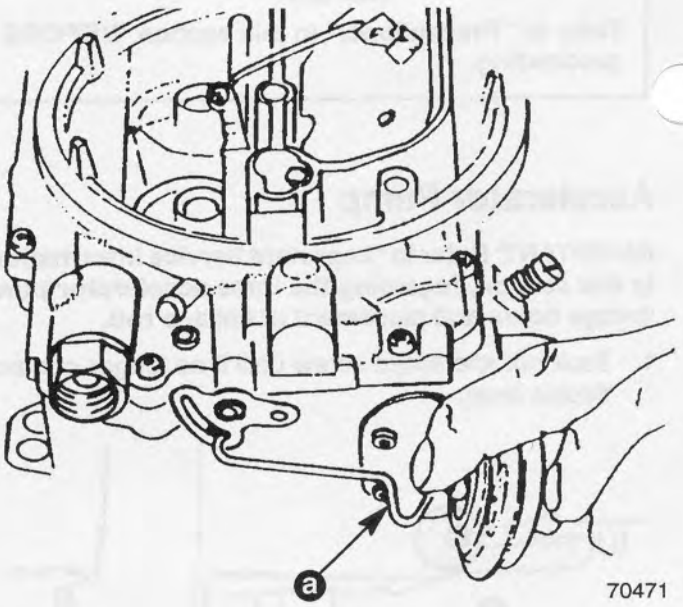
70471



70471

a - Vacuum Diaphragm
b - Choke Plate
c - Housing
d - Gap Measurement

2. Bend choke pull-off linkage to achieve setting given in Step 1.

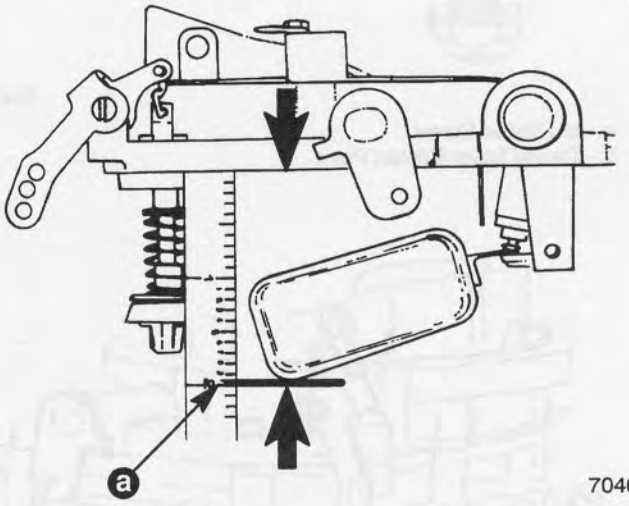


70471

a - Linkage (Bend)

Float Drop

1. Measure float drop from bottom side of carburetor top to toe of float (lowest part), as shown. It must be set at 2 in. (51 mm).

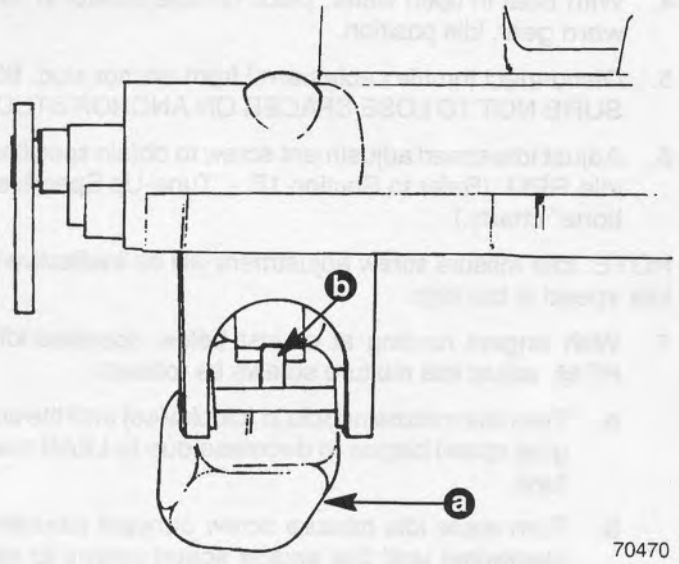


70469

a - Drop Measurement

2. If float drop is not correct, hold hinge pin firmly and bend tab shown, as needed.

IMPORTANT: Do not put pressure on fuel needle valve and seat while bending tab, or damage may result.

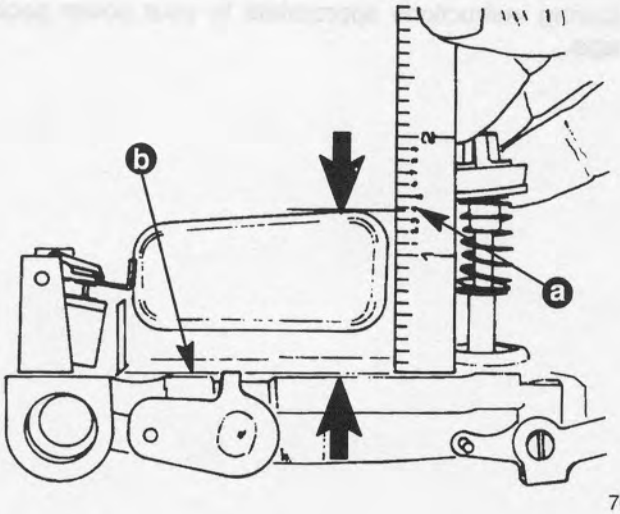


70470

a - Float
b - Tab (Bend)

Float Level

1. Measure float level from bottom side of carburetor top (with gasket in place) to toe of float as shown. It must be set at 1-9/32 in. (33 mm).

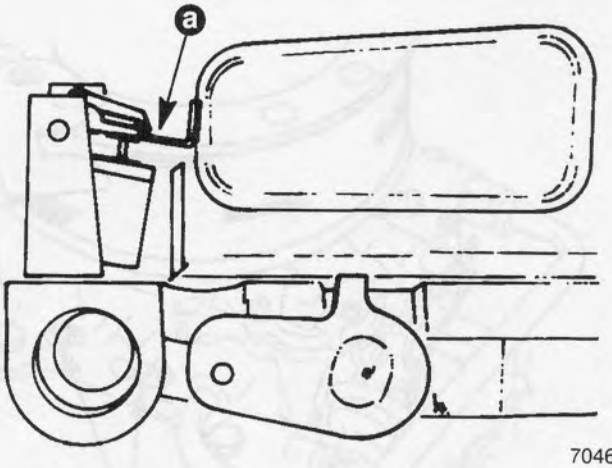


70468

a - Float Level Measurement
b - Gasket

2. If float level requires adjustment, hold hinge pin firmly and bend float arm shown, as needed.

IMPORTANT: Do not put pressure on fuel needle valve and seat while bending tab, or damage may result.



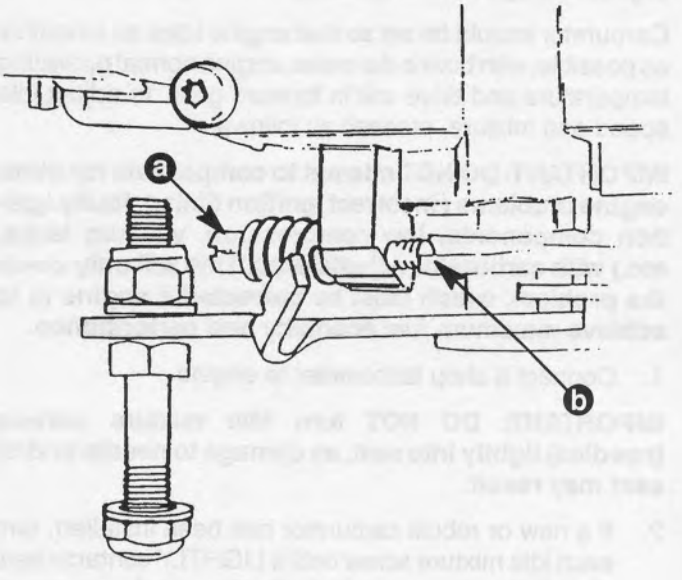
70468

a - Float Level Tab (Bend)

Preliminary Idle Speed and Mixture

Initial start settings are given following. Make final adjustment with engine running (refer to "Final Idle Speed and Mixture").

1. Turn idle speed screw until it contacts throttle lever.

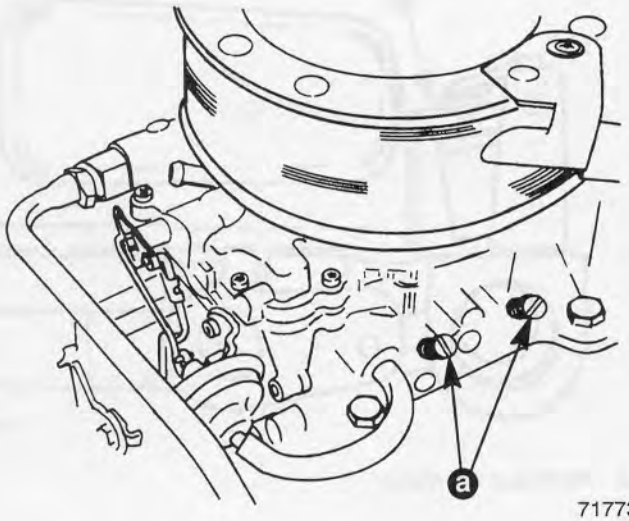


70474

a - Idle Speed Screw
b - Throttle Lever Contact Point

2. Turn idle mixture screws (needles) in (clockwise) until LIGHTLY seated, then back out two to three turns.

IMPORTANT: Do not turn idle mixture screws tightly against seat, as damage to seat and/or needle may result.



a - Idle Mixture Screws (Needles)

Final Idle Speed and Mixture

IMPORTANT: Boat MUST BE in the water and engine at normal operating temperature to accurately check and adjust idle speed and mixture.

Carburetor should be set so that engine idles as smoothly as possible, with boat in the water, engine normal operating temperature and drive unit in forward gear. To adjust idle speed and mixture, proceed as follows:

IMPORTANT: DO NOT attempt to compensate for other engine problems (incorrect ignition timing, faulty ignition components, low compression, vacuum leaks, etc.) with carburetor adjustments. This will only cover the problem, which must be corrected if engine is to achieve maximum fuel economy and performance.

1. Connect a shop tachometer to engine.

IMPORTANT: DO NOT turn idle mixture screws (needles) tightly into seat, as damage to needle and/or seat may result.

2. If a new or rebuilt carburetor has been installed, turn each idle mixture screw until it LIGHTLY contacts seat (if not already accomplished), then back out two to three turns. This will provide a sufficient setting to allow starting the engine.
3. Start engine and run at 1500 RPM until engine reaches normal operating temperature.

⚠ WARNING

DO NOT leave helm unattended while performing idle speed and mixture adjustments, following. BE CAREFUL NOT TO ACCIDENTALLY ACCELERATE ENGINE WHILE PERFORMING ADJUSTMENTS.

4. With boat in open water, place remote control in forward gear, idle position.
5. Disconnect throttle cable barrel from anchor stud. BE SURE NOT TO LOSE SPACER ON ANCHOR STUD.
6. Adjust idle speed adjustment screw to obtain specified idle RPM. (Refer to Section 1B - "Tune-Up Specifications" charts.)

NOTE: Idle mixture screw adjustment will be ineffective if idle speed is too high.

7. With engine running at or just below specified idle RPM, adjust idle mixture screws as follows:
   a. Turn idle mixture needle in (clockwise) until the engine speed begins to decrease due to LEAN mixture.
   b. Turn same idle mixture screw outward (counterclockwise) until the engine speed begins to decrease due to a RICH mixture.
   c. Turn screw in to a point between these two extremes to obtain maximum engine smoothness and RPM.
   d. Repeat procedure with other mixture screw.
   e. Readjust idle speed adjusting screw, if necessary, to obtain specified idle RPM.
8. Place remote control in neutral. Turn ignition OFF.
9. Refer to Section 2. **Install and adjust** throttle cable following instructions appropriate to your power package.

Repair

NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

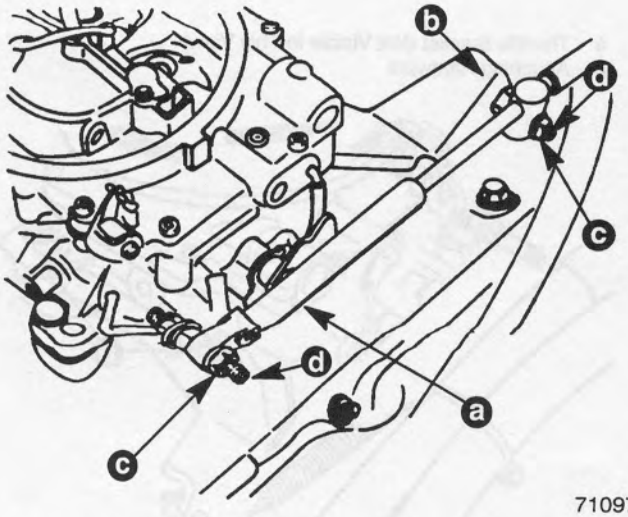
Removal

IMPORTANT: Carburetor malfunctions are, in many cases, caused by the presence of dirt, water or other foreign matter in carburetor. To aid in diagnosis, carefully remove carburetor from engine without draining fuel from bowl. Contents of fuel bowl may, then, be inspected for contamination as carburetor is disassembled.

1. Turn off fuel supply at fuel tank.
2. Remove carburetor cover. Remove crankcase ventilation hoses from flame arrestor, then remove flame arrestor.

IMPORTANT: Place a clean cloth in bores of carburetor to prevent dirt and foreign material from falling into bores.

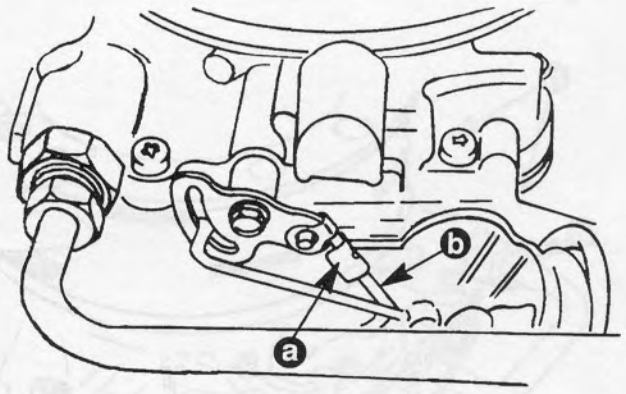
3. Disconnect throttle cable attaching hardware from throttle bracket and throttle lever anchor studs. Remove throttle cable.



71097

a - Throttle Cable
b - Bracket
c - Attaching Hardware
d - Anchor Studs

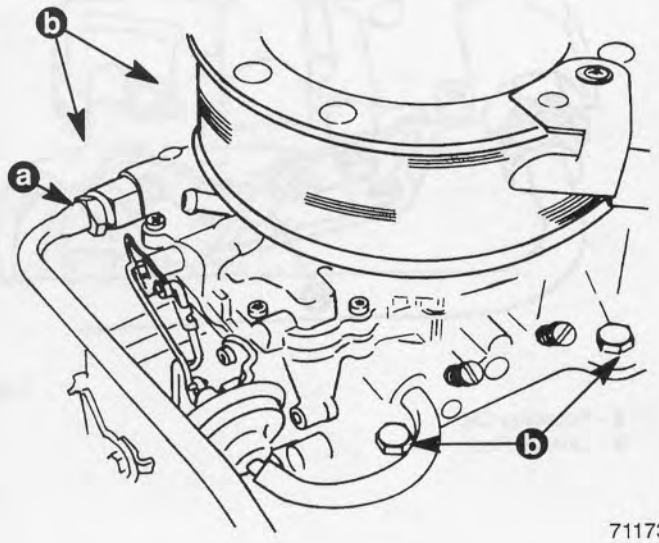
4. Disconnect retaining clip and choke linkage rod.



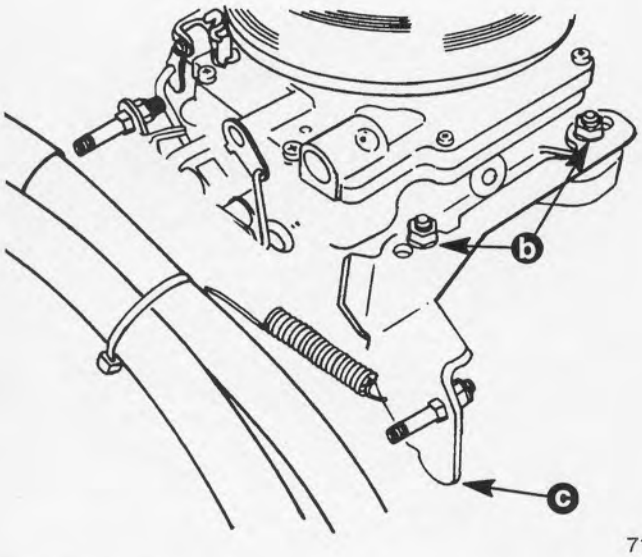
71881

a - Retaining Clip
b - Linkage Rod

5. Remove fuel line and carburetor attaching hardware. Remove carburetor and throttle bracket. Discard old gasket from carburetor.



71173



71172

a - Fuel Line
b - Attaching Hardware
c - Throttle Bracket

6. Remove adaptor/wedge plate (if so equipped) from manifold and discard old gasket.
7. Place a clean cloth over intake manifold openings.

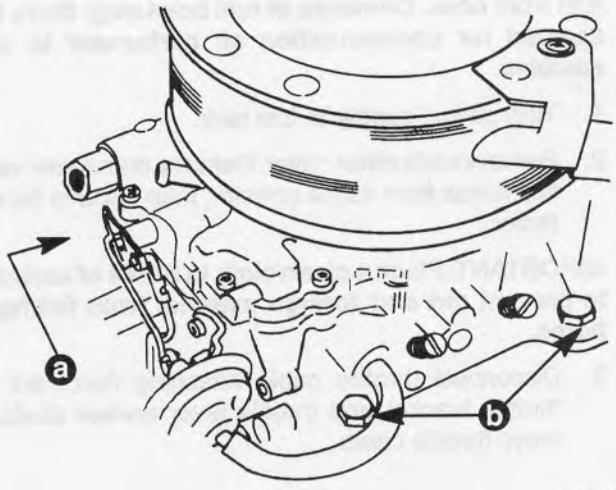
IMPORTANT: Covering intake manifold prevents entry of dirt or foreign material through openings.

Installation

1. Place new gasket on intake manifold.
2. If so equipped, install adaptor or wedge plate, depending on model. Place new gasket on top.

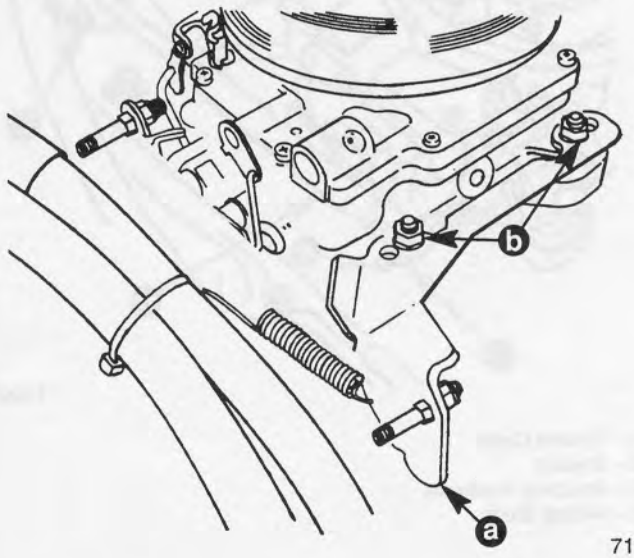
IMPORTANT: Carburetor is calibrated for use with an adaptor or wedge plate if the model was originally so equipped. Be certain to install adaptor or wedge plate if it was present upon disassembly.

3. Install carburetor and throttle bracket with attaching hardware. Torque fasteners to 132 lb. in. (15 N•m).



71173

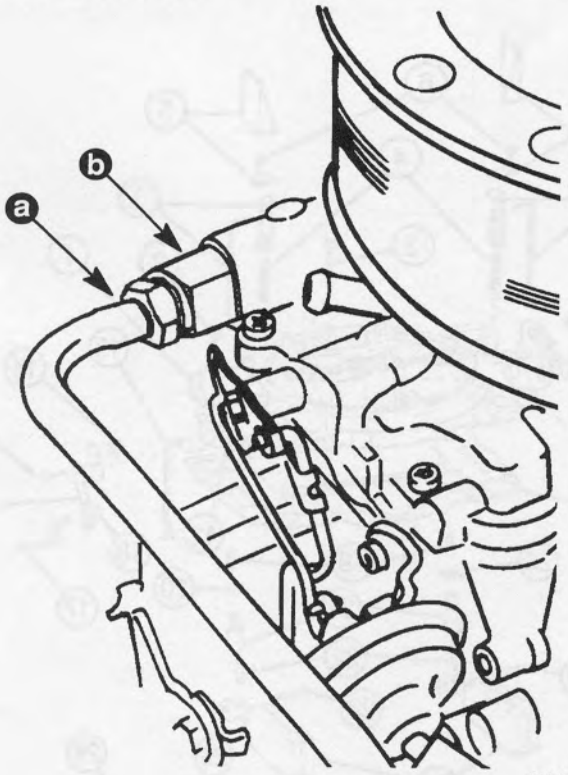
a - Throttle Bracket (Not Visible in This View)
b - Attaching Hardware



71172

a - Throttle Bracket
b - Attaching Hardware

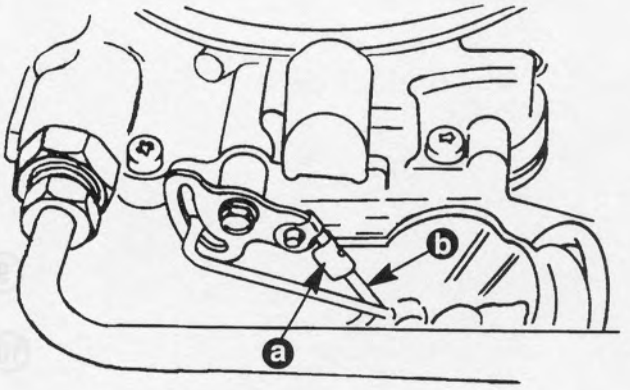
4. Install fuel line. To prevent over-tightening, hold fuel inlet filter nut with suitable wrench and tighten fuel line connector securely.



71173

a - Fuel Line
b - Fuel Inlet Filter Nut

5. Connect choke linkage rod and install retaining clip.

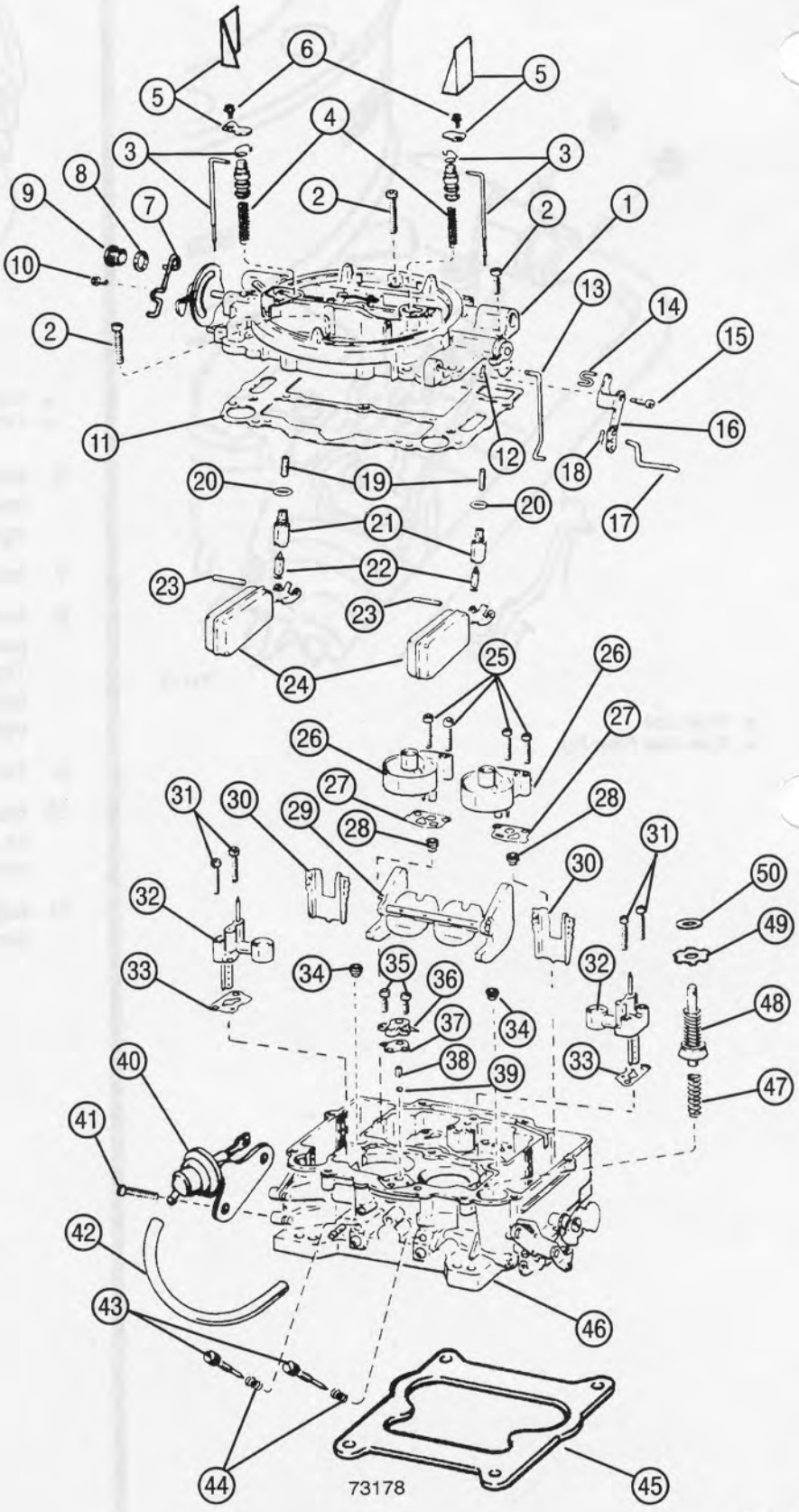


71881

a - Clip
b - Linkage Rod

6. Refer to Section 2. **Install and adjust** throttle cable following instructions appropriate to your power package.
7. Install flame arrestor and tighten nut securely.
8. Reconnect battery cables to battery by first installing positive battery cable to positive (+) battery terminal. Tighten clamp securely. Then, install negative battery cable to negative (–) battery terminal. Tighten clamp securely.
9. Turn on fuel supply at fuel tank.
10. Start engine and check for gasoline leaks. If leaks exist, **STOP ENGINE IMMEDIATELY** and recheck connections.
11. Adjust idle speed and idle mixture, as previously outlined under "Adjustments."

Exploded View



1 - Air Horn (Carburetor Top)
2 - Screw
3 - Metering Rod Assembly
4 - Spring, Metering Rod
5 - Cover (with Air Deflector), Metering Rod
6 - Screw
7 - Linkage Rod, Choke Pull-Off
8 - Sealing Washer
9 - Fuel Inlet Fitting
10- Screw
11- Gasket
12- Wire Clip
13- Linkage Rod, Choke Plate
14- S-Link
15- Screw
16- Accelerator Pump Lever
17- Linkage Rod, Accelerator Pump
18- Wire Clip
19- Filter, Fuel Inlet
20- Gasket
21- Seat, Fuel Inlet
22- Needle Valve, Fuel Inlet
23- Pin
24- Float
25- Screw
26- Secondary Venturi Cluster
27- Gasket
28- Jet, Secondary Fuel
29- Secondary Air Valve and Weight Assembly
30- Baffle Plate, Float Bowl
31- Screw
32- Primary Venturi Cluster
33- Gasket
34- Jet, Primary Fuel
35- Screw
36- Fuel Pump Injector Housing
37- Gasket
38- Check-Weight (or Check-Spring, if So Equipped)
39- Check-Ball
40- Diaphragm, Choke Pull-Off
41- Screw
42- Vacuum Hose
43- Idle Mixture Screw
44- Spring, Idle Mixture Screw
45- Gasket, Carburetor Base
46- Float Bowl/Body (Carburetor Bottom)
47- Spring, Accelerator Pump
48- Accelerator Pump
49- Plunger Guide
50- Plunger Washer

7132

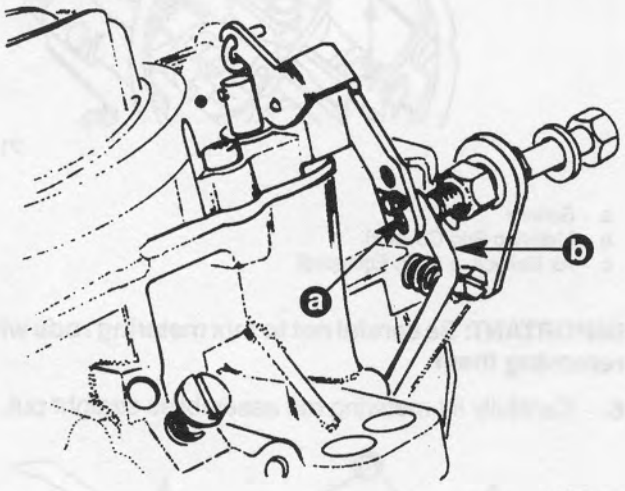
Weber Carburetor

Disassembly

The following is a step-by-step procedure for completely overhauling carburetor after removal from engine. In many cases, however, complete overhaul is not necessary and, in these cases, only the steps required to repair the carburetor malfunction should be performed. Read the instructions carefully to prevent doing unnecessary steps.

IMPORTANT: Before performing any service on carburetor, it is essential that carburetor be placed in a holding fixture to prevent possible damage to throttle valves.

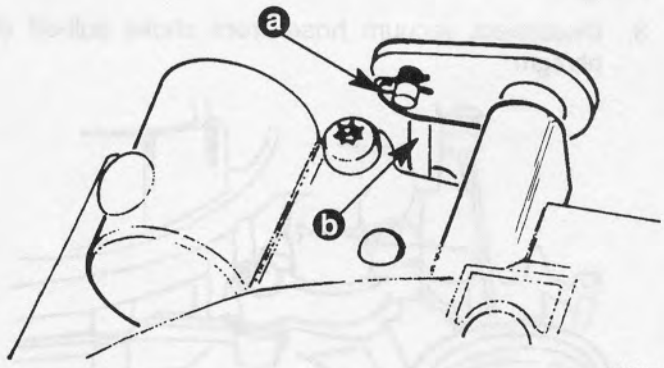
1. Remove wire clip to disconnect accelerator pump linkage.



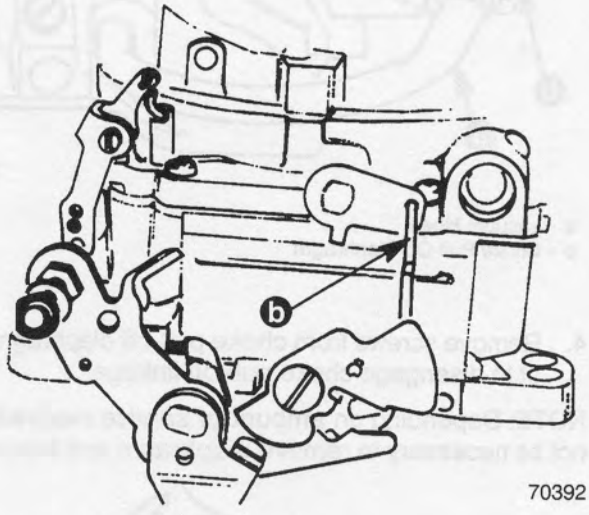
70390

a - Wire Clip
b - Accelerator Pump Linkage Rod

2. Remove wire clip to disconnect choke plate linkage.



70391

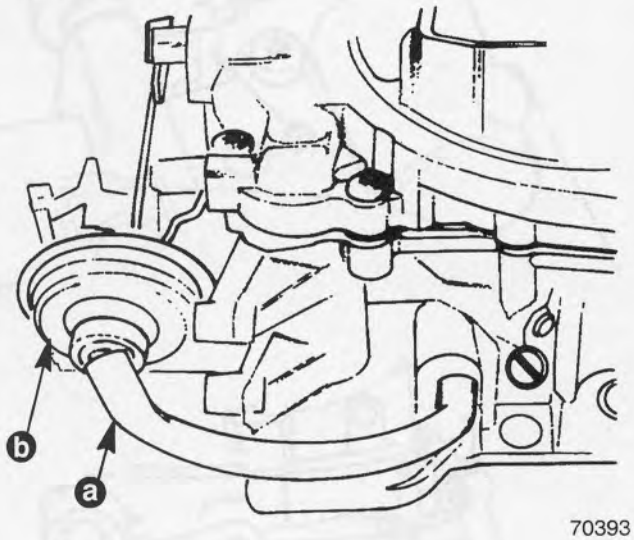


70392

a - Wire Clip
b - Choke Plate Linkage Rod

NOTE: Do not remove vacuum hose if not servicing diaphragm.

3. Disconnect vacuum hose from choke pull-off diaphragm.

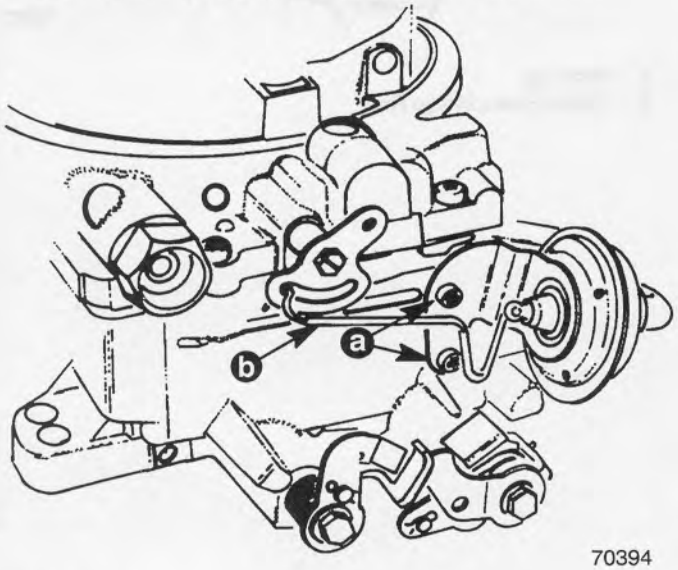


70393

a - Vacuum Hose
b - Choke Pull-Off Diaphragm

4. Remove screws from choke pull-off diaphragm bracket to disengage choke pull-off linkage.

NOTE: Depending on amount of service required, it may not be necessary to remove diaphragm and bracket.

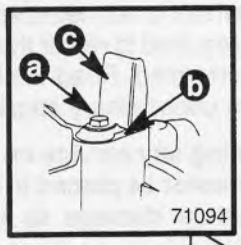


70394

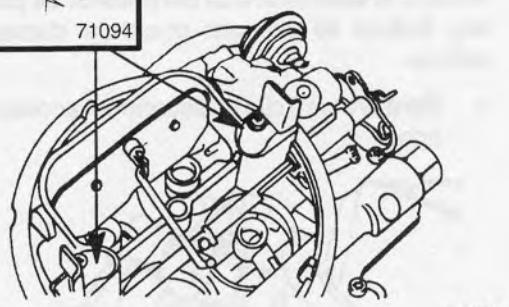
a - Screws
b - Linkage Rod

IMPORTANT: Metering rods should always be removed before separating top and bottom halves of carburetor.

5. Loosen (not necessary to remove, depending on amount of service required) metering rod cover screws. Turn cover, or remove, to expose metering rod.



71094

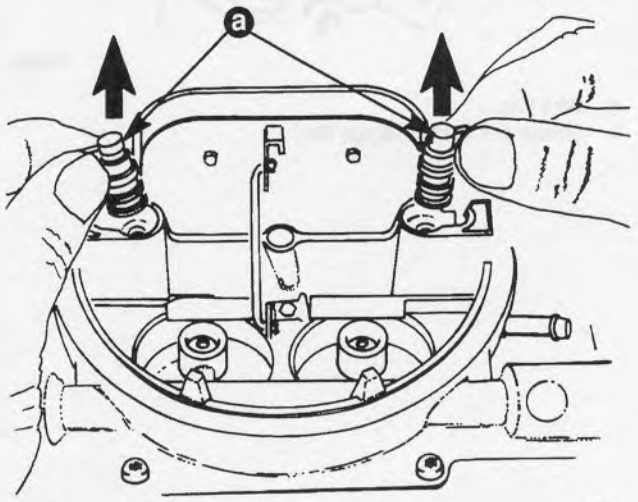


71095

a - Screws
b - Metering Rod Cover(s)
c - Air Deflectors (if So Equipped)

IMPORTANT: Be careful not to mix metering rods when removing them.

6. Carefully lift metering rod assemblies straight out.

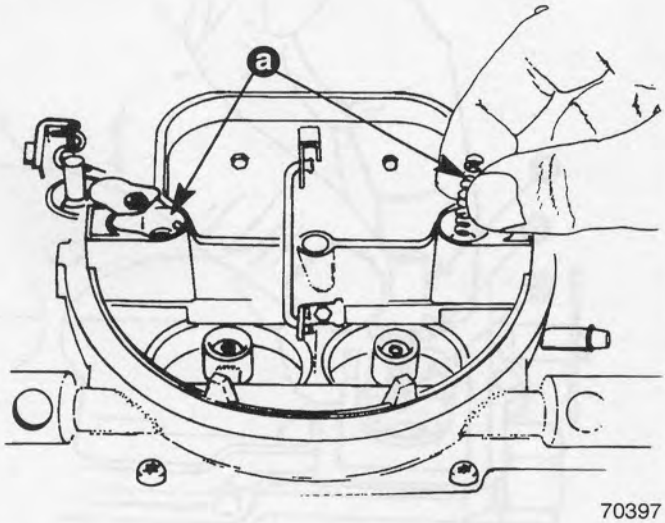


70396

a - Metering Rod Assembly(s)

7. Remove metering rod springs.

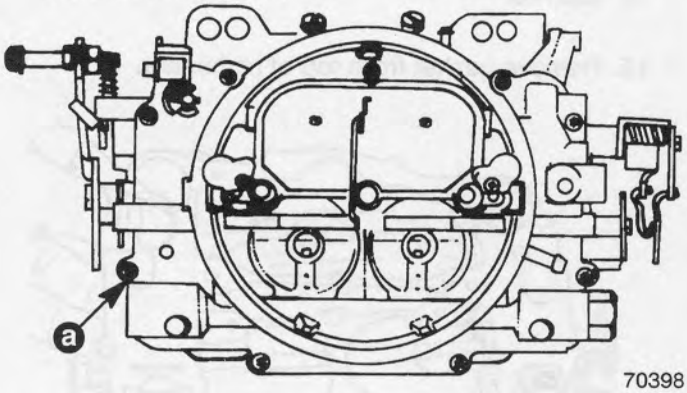
IMPORTANT: Metering rod springs are color coded and should not be interchanged with other carburetors.



70397

a - Spring(s)

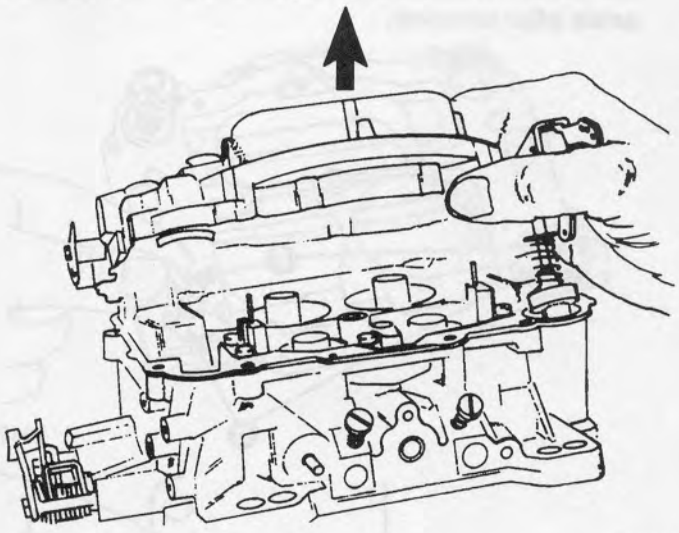
8. Remove nine screws to separate top and bottom halves of carburetor.



70398

a - Screw(s)

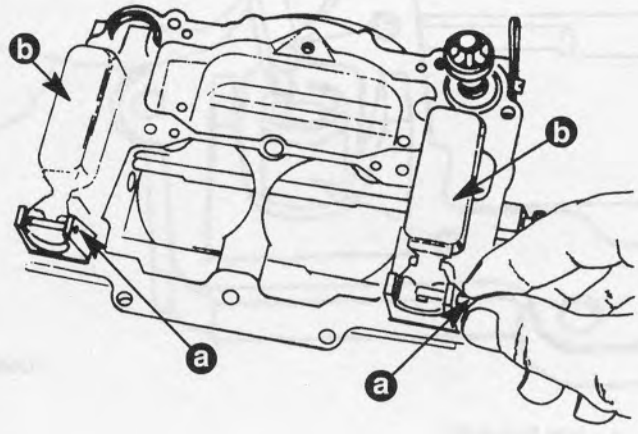
9. Carefully lift off carburetor top and disconnect choke linkage.



70399

10. Slide pin out to remove the float.

IMPORTANT: Be careful not to mix up floats after removal.

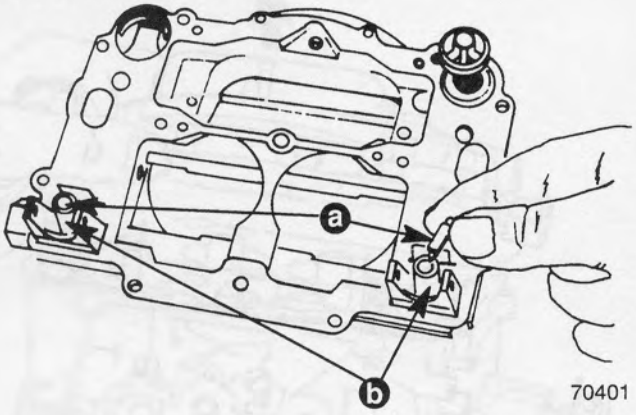


70400

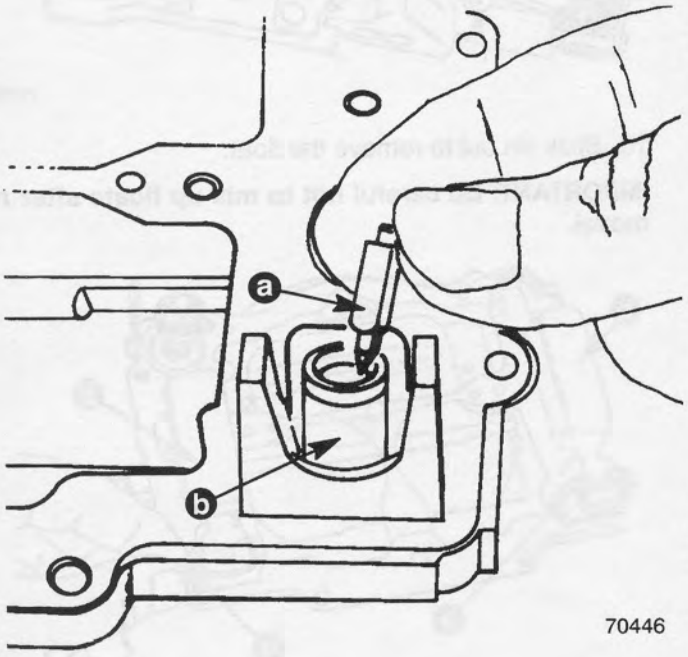
a - Pin(s)
b - Float(s)

11. Remove inlet needle from seat.

IMPORTANT: Be careful not to mix up inlet needles and seats after removal.



70401

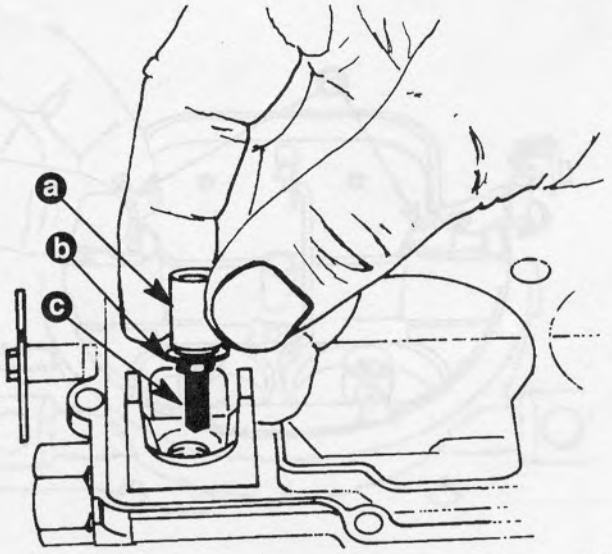


70446

a - Inlet Needle(s)
b - Seat(s)

12. Remove seat, gasket, and inlet filter.

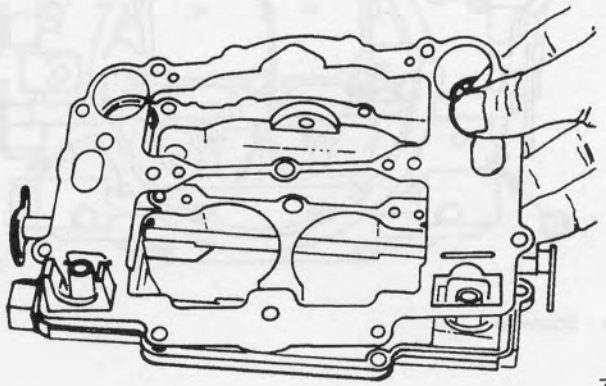
IMPORTANT: Be careful not to mix up seats after removal.



70447

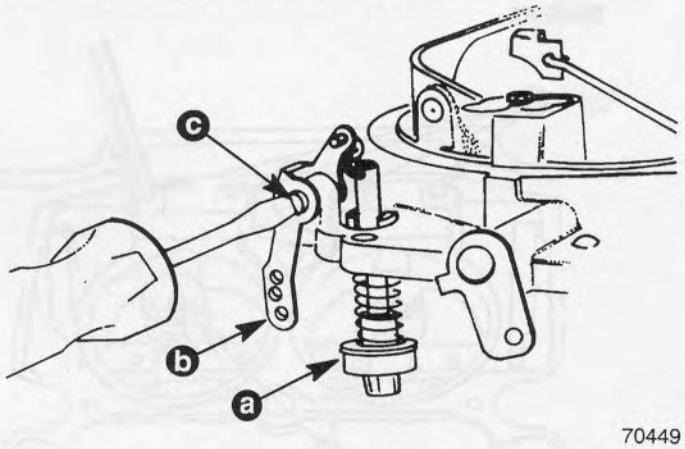
a - Seat
b - Gasket
c - Inlet Filter

13. Remove gasket from top of carburetor.



70448

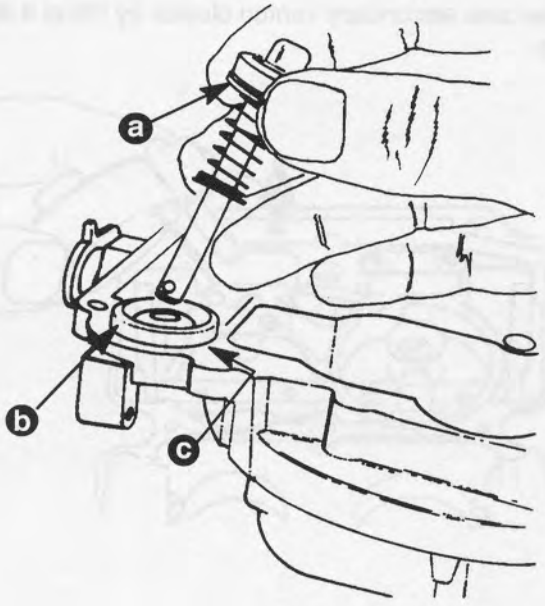
14. Remove accelerator pump lever.



70449

a - Accelerator Pump
b - Accelerator Pump Lever
c - Retaining Screw

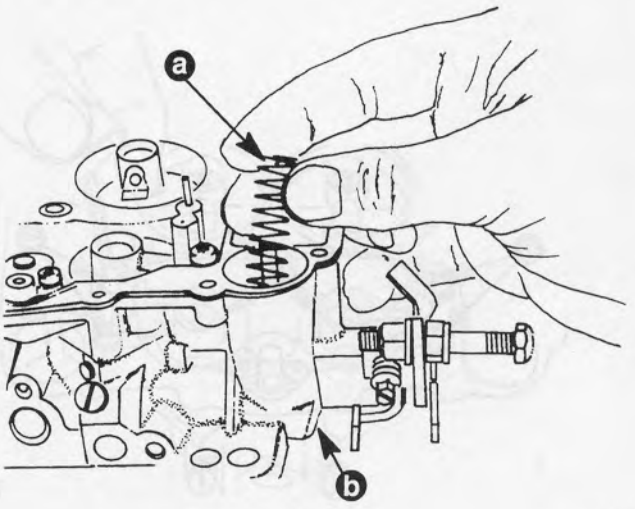
15. Remove accelerator pump.



70450

a - Accelerator Pump
b - Plunger Guide
c - Plunger Washer (Not Visible in This View)

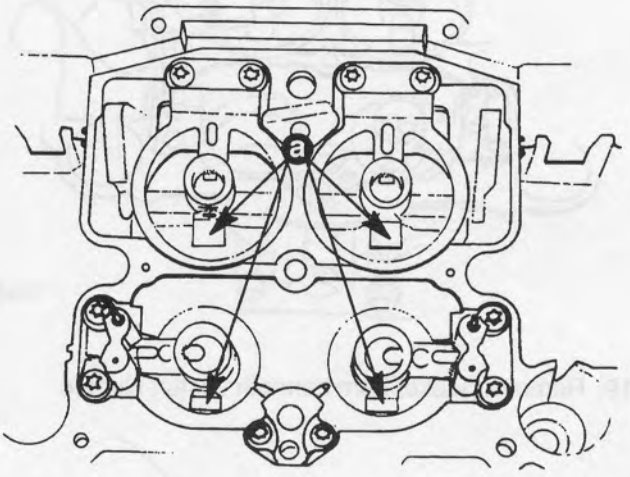
16. Remove accelerator pump spring from bottom half of carburetor.



70451

a - Accelerator Pump Spring
b - Carburetor Bottom

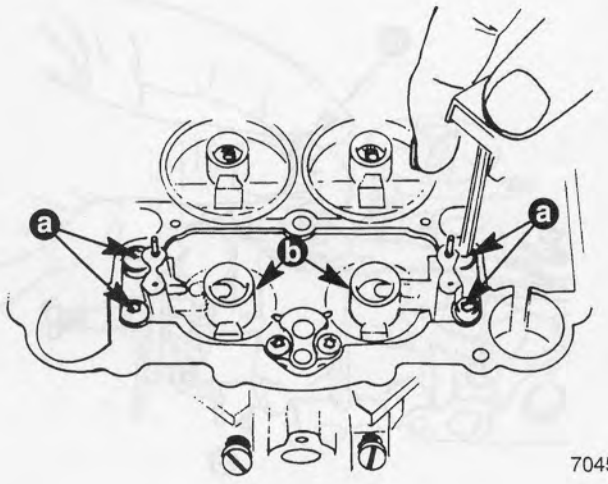
IMPORTANT: Before removing venturi clusters, it is important to note which clusters are equipped with a "distribution tab." This distribution tab arrangement varies from one carburetor to another.



70452

a - Distribution Tab(s) (Location and Total Number May Vary)

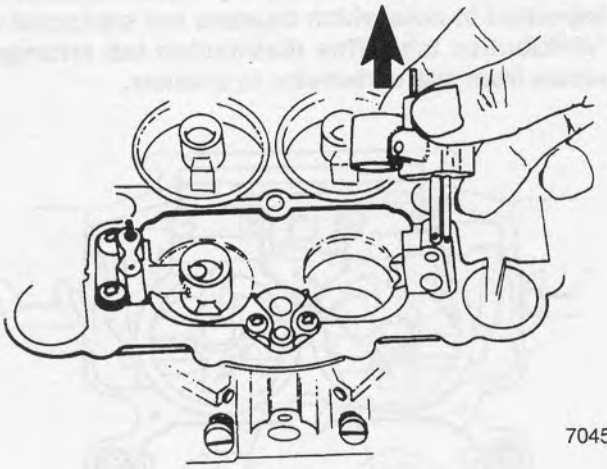
17. Remove two screws that secure primary venturi cluster.



70453

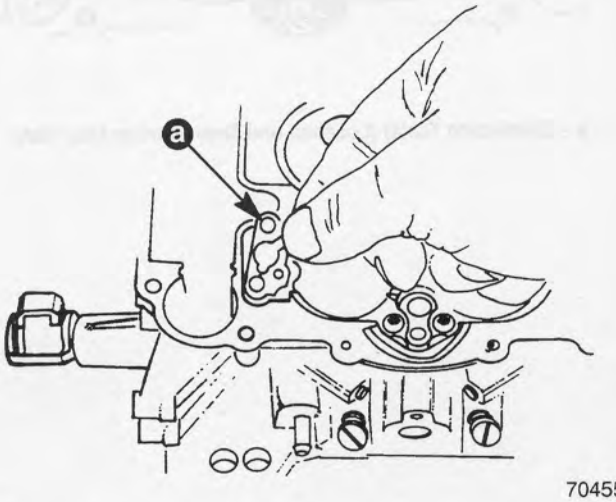
a - Screw(s) (Two Each Side)
b - Primary Venturi Cluster(s)

18. Remove primary venturi cluster by lifting straight up.



70454

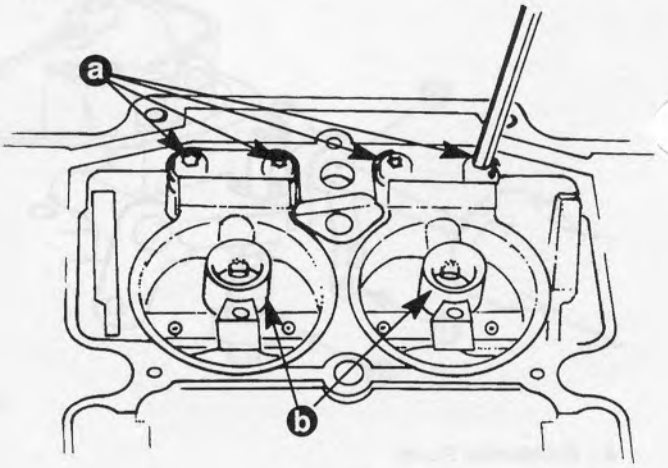
19. Remove gasket from beneath venturi cluster.



70455

a - Gasket, Primary Venturi Cluster

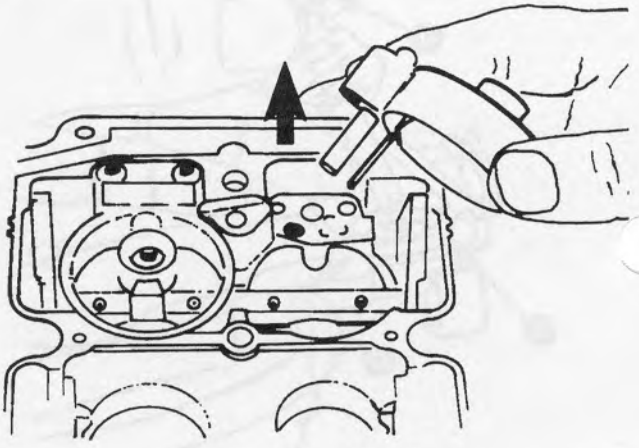
20. Remove two screws that secure secondary venturi clusters.



70456

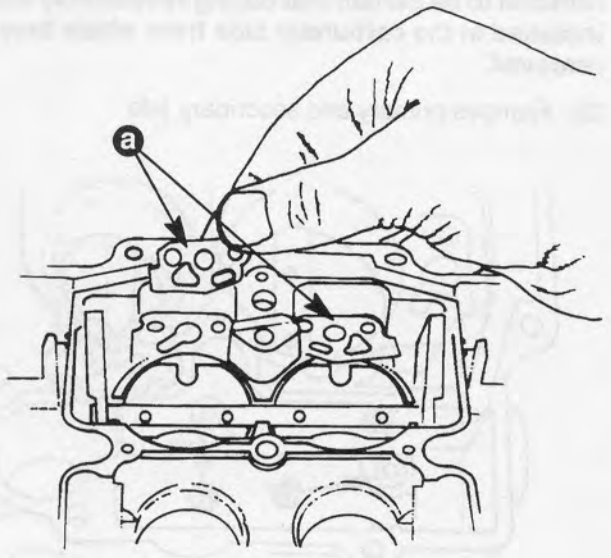
a - Screw(s) (Two Each Side)
b - Secondary Venturi Cluster(s)

21. Remove secondary venturi cluster by lifting it straight up.



70457

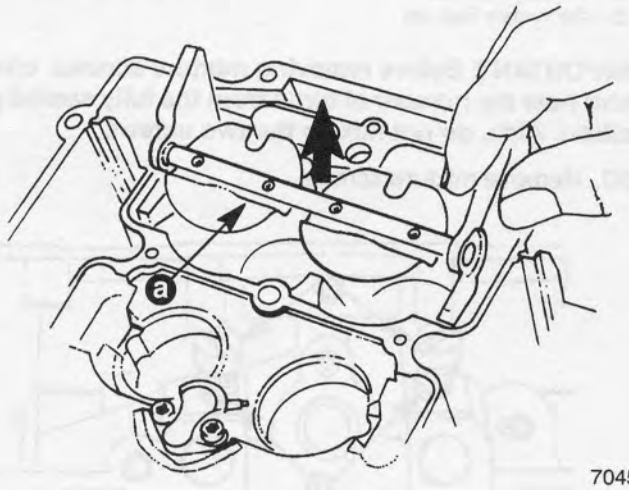
22. Remove gaskets from beneath secondary venturi clusters.



70458

a - Gasket, Secondary Venturi Cluster

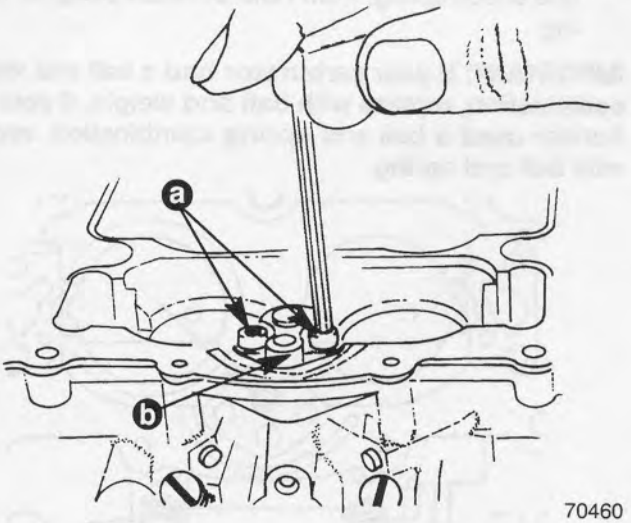
23. Remove secondary air valve and weight assembly by lifting it straight out.



70459

a - Secondary Air Valve and Weight Assembly

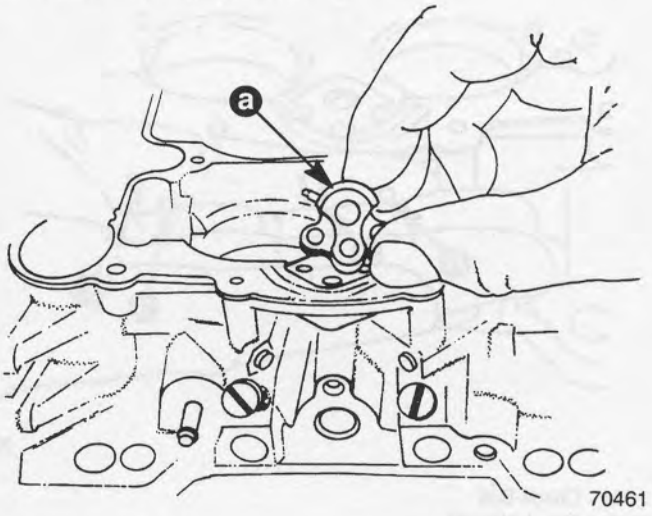
24. Remove two screws that secure pump jet housing.



70460

a - Screw(s)
b - Pump Jet Housing

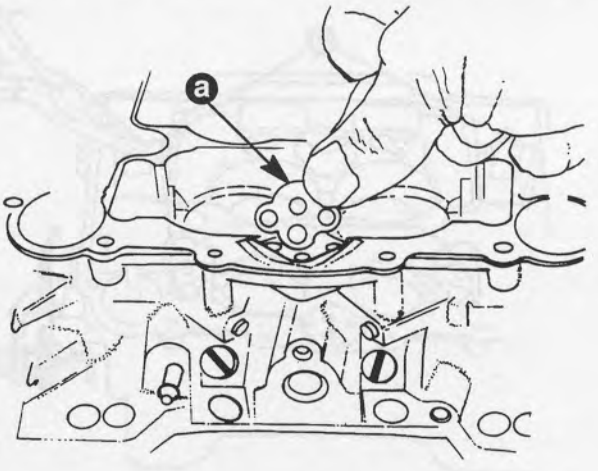
25. Remove pump jet housing.



70461

a - Pump Jet Housing

26. Remove gasket from beneath pump jet housing.

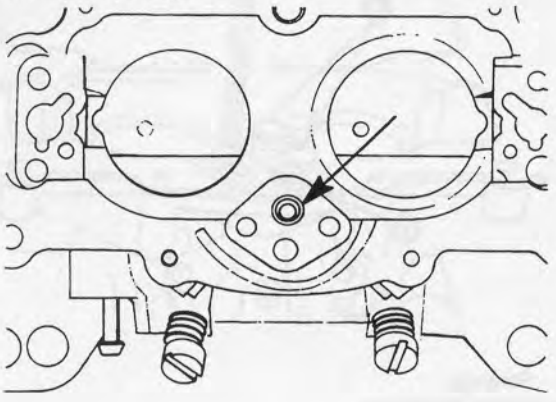


70462

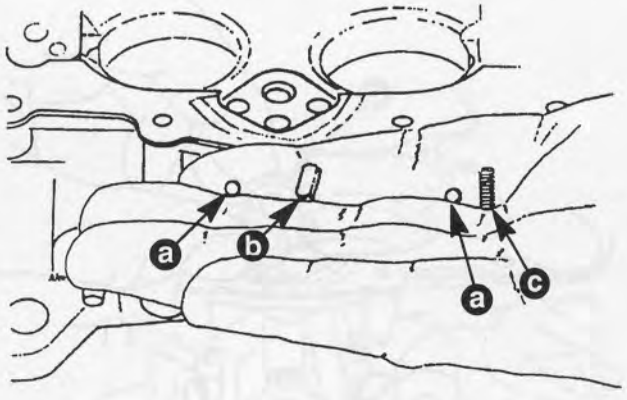
a - Gasket, Pump Jet Housing

27. Remove check-ball and check-weight, or check-ball and check-spring, from hole beneath pump jet housing.

IMPORTANT: If your carburetor had a ball and weight combination, replace with ball and weight. If your carburetor used a ball and spring combination, replace with ball and spring.



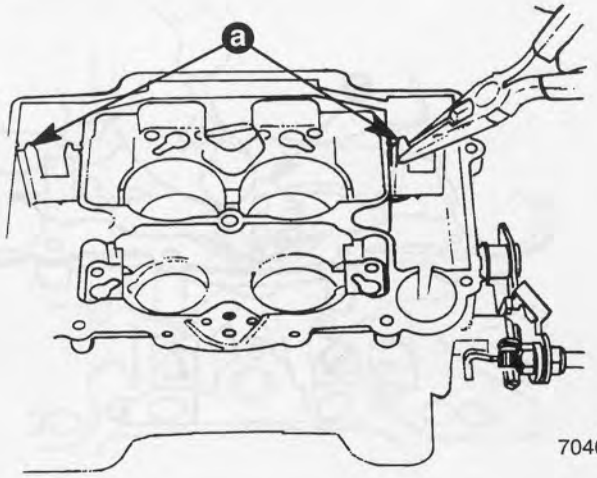
70463



70464

a - Check-Ball
b - Check-Weight
c - Check-Spring

28. Remove float bowl baffle plates.

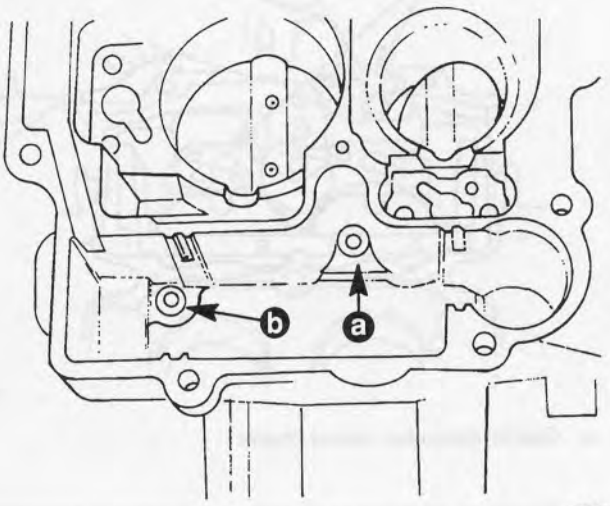


70465

a - Baffle Plate

IMPORTANT: Do not mix up the primary and secondary jets. Make note of the jet sizes and their location before removal to be certain that during reassembly they are installed in the carburetor side from which they were removed.

29. Remove primary and secondary jets.

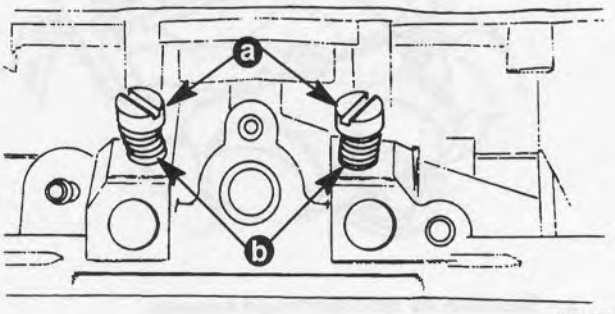


70466

a - Primary Fuel Jet
b - Secondary Fuel Jet

IMPORTANT: Before removing mixture screws, check and note the number of turns from the fully seated position. Also, do not mix up the two screws.

30. Remove mixture screws.



70467

a - Idle Mixture Screw
b - Spring, Idle Mixture Screw

Cleaning and Inspection

⚠CAUTION

Rubber, plastic parts, pump plungers or diaphragms cannot be immersed in carburetor cleaner.

⚠CAUTION

Avoid damage to carburetor. Do not leave carburetor in immersion-type cleaner for more than two hours.

IMPORTANT: Do not immerse metering rod springs in carburetor cleaner; the color, if not "natural" metal, may be removed. Clean separately as needed.

1. Clean metal carburetor parts in a commercial, immersion-type cleaner, until all deposits have been removed. Follow manufacturer's instructions of cleaner being used for proper cleaning and rinsing procedures.

⚠CAUTION

Avoid personal injury. Always wear safety glasses when using compressed air.

2. Blow out passages with compressed air. Do not drill through passages.

IMPORTANT: DO NOT use a wire or drill to clean jets, passages, or tubes in carburetor, as this may enlarge orifices and seriously affect carburetor calibration.

3. Wipe all parts that cannot be cleaned in immersion cleaner with a clean, dry cloth.
4. Carefully inspect all carburetor parts for damage or wear; pay particular attention to the following:
   a. **Idle mixture screws -** Replace if damaged or worn.
   b. **Fuel inlet needle valve and seat -** Replace with new needle and seat if worn or damaged.
   c. **Casting surfaces -** Inspect accelerator pump plunger well for scoring or deposits. Replace worn or corroded components.
   d. **All linkage rods and levers -** Replace if worn or damaged.
   e. **Accelerator pump and plunger parts -** Replace pump and parts if worn or damaged.
   f. **Float assembly and hinge pin -** Float weight of each should be the same. Replace either if fuel can be heard inside when shaken. Check hinge pin and holes for wear. Replace components if worn or defective.
   g. **Throttle valves and shafts -** Check for binding (through entire operating range, making sure valves open and close completely) or for looseness in carburetor body.

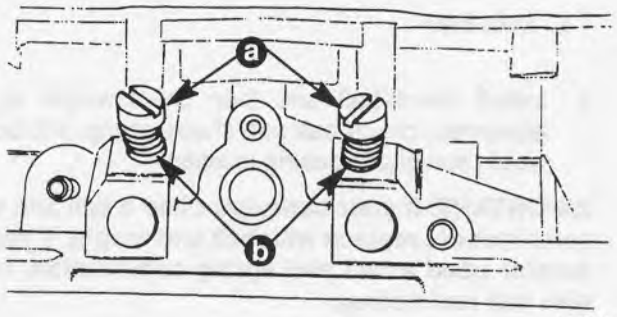
IMPORTANT: DO NOT remove throttle valves. If any of the throttle parts or float bowl/carburetor body shaft bores are found to be worn or damaged, carburetor replacement is required.

   h. **Choke valve and shaft/lever assembly -** Check shaft and lever for excessive looseness in air horn. Check choke valve and shaft/lever assembly for binding through entire operating range. Air horn assembly must be replaced if choke valve and shaft/lever are worn.
5. Check that choke pull-off diaphragm plunger retracts when vacuum is applied to unit, and that it holds vacuum (plunger remains seated if vacuum is maintained).

Reassembly

1. Install mixture screws (needles) with springs in place. Turn idle mixture screws in (clockwise) until LIGHTLY seated, then back out two to three turns if previous settings were not noted on disassembly.

IMPORTANT: Do not turn idle mixture screws tightly against seat, as damage to seat and/or needle may result.

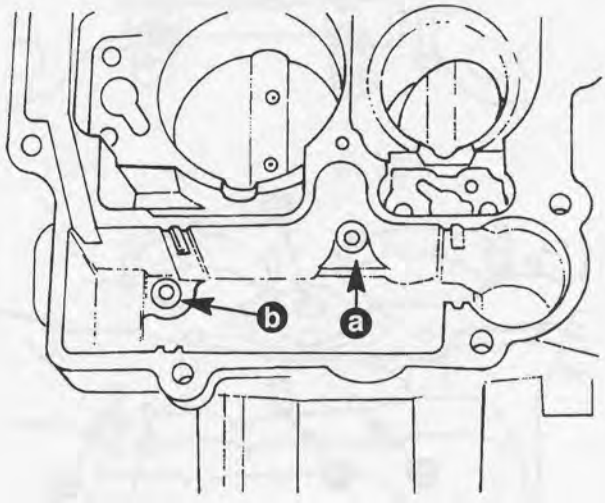


70467

a - Idle Mixture Screw
b - Spring, Idle Mixture Screw

2. Install the primary and secondary jets.

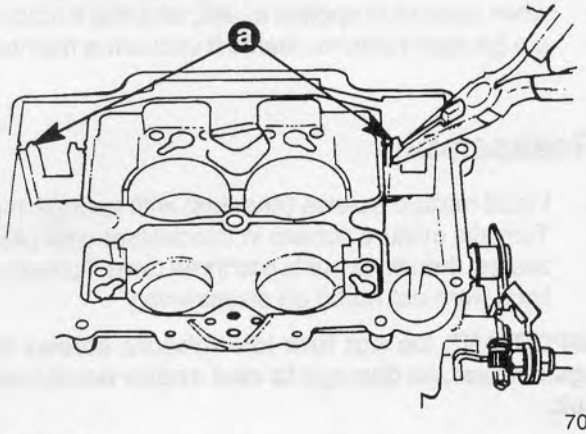
IMPORTANT: Be sure that primary and secondary jets are installed in the appropriate location. Be sure that the size matches the same size recorded during disassembly.



70466

a - Primary Fuel Jet
b - Secondary Fuel Jet

3. Install the float bowl baffle plates.

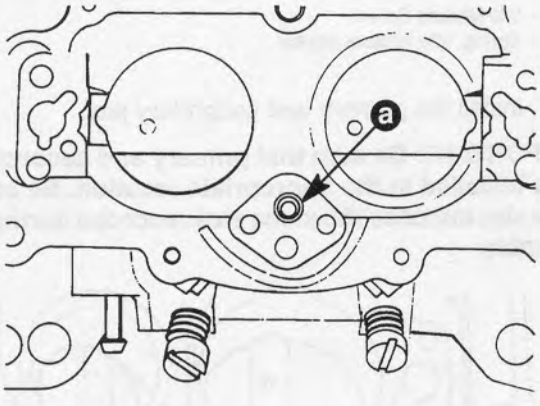


70465

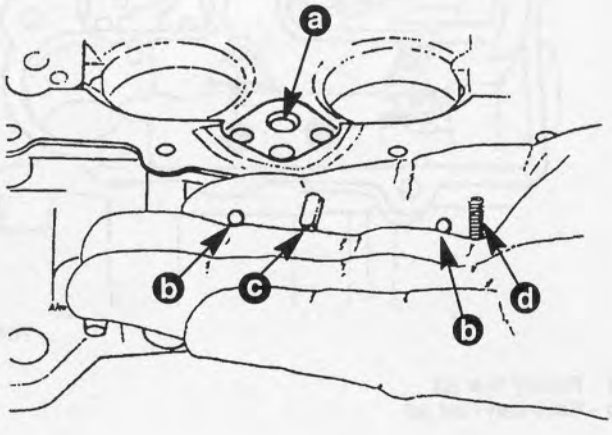
a - Baffle Plate

4. install check-ball and then check-weight or, if so equipped, check-ball and check-spring, into bore beneath pump jet housing location.

IMPORTANT: If your carburetor had a ball and weight combination, replace with ball and weight. If your carburetor used a ball and spring combination, replace with ball and spring.



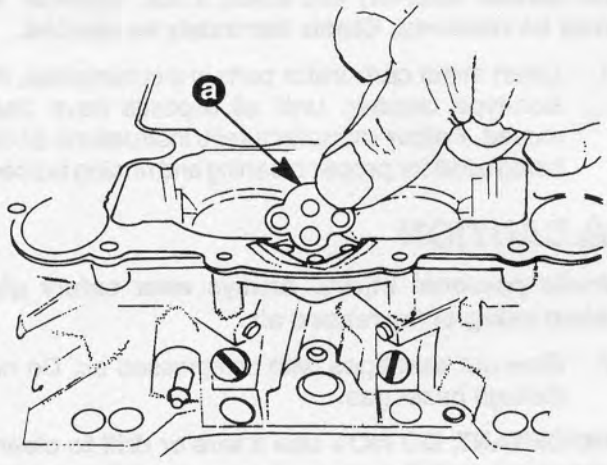
70463



70464

a - Bore
b - Check-Ball
c - Check-Weight
d - Check-Spring

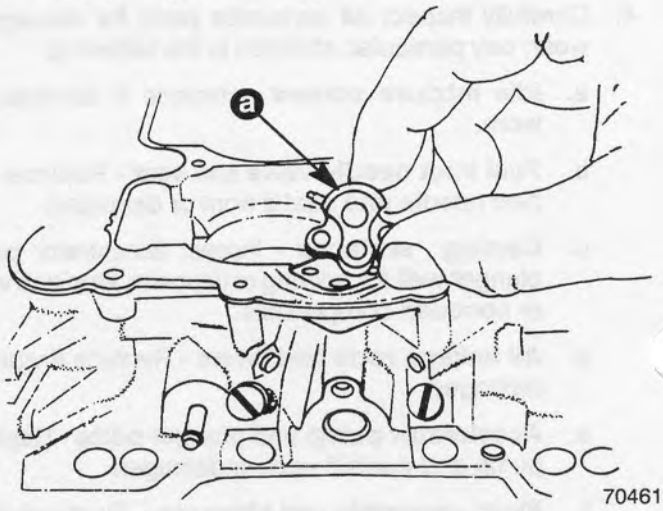
5. Position pump jet housing gasket.



70462

a - Gasket, Pump Jet Housing

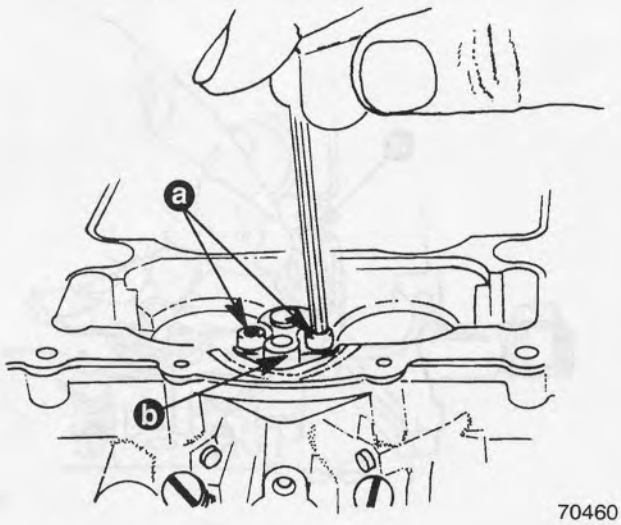
6. Install pump jet housing.



70461

a - Pump Jet Housing

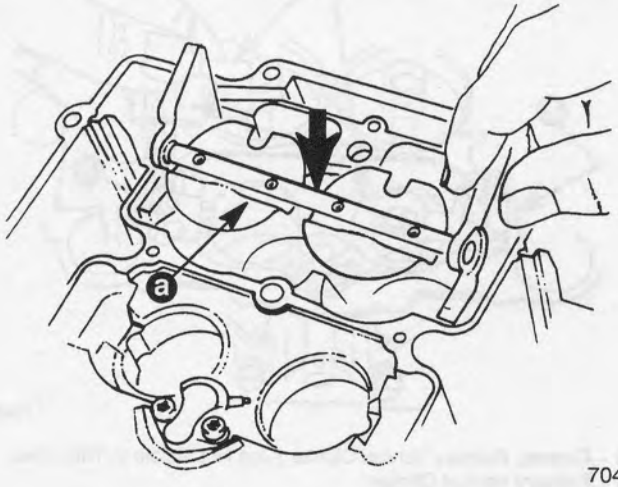
7. Install two screws that secure pump jet housing. Tighten securely.



70460

a - Screws
b - Pump Jet Housing

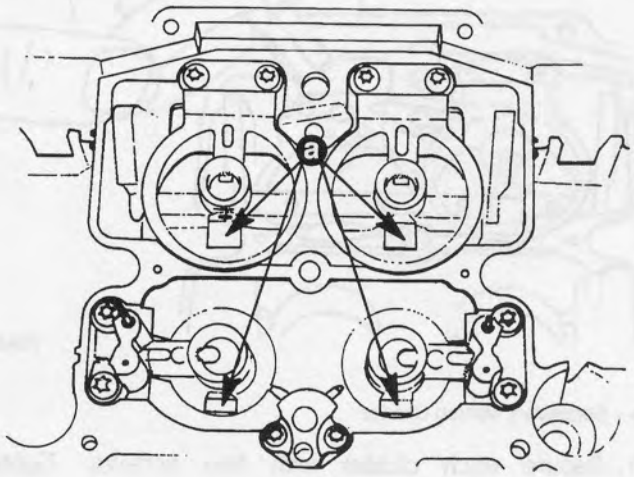
8. Install the secondary air valve and weight assembly.



70459

a - Secondary Air Valve and Weight Assembly

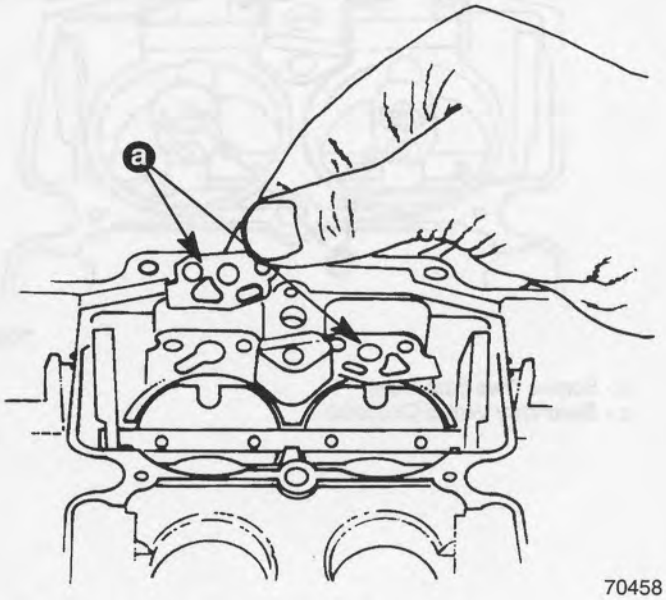
IMPORTANT: Before installing venturi clusters, it is important to note which clusters were equipped with a "distribution tab." This distribution tab arrangement varies from one carburetor to another.



70452

a - Distribution Tab(s) (Location and Total Number May Vary)

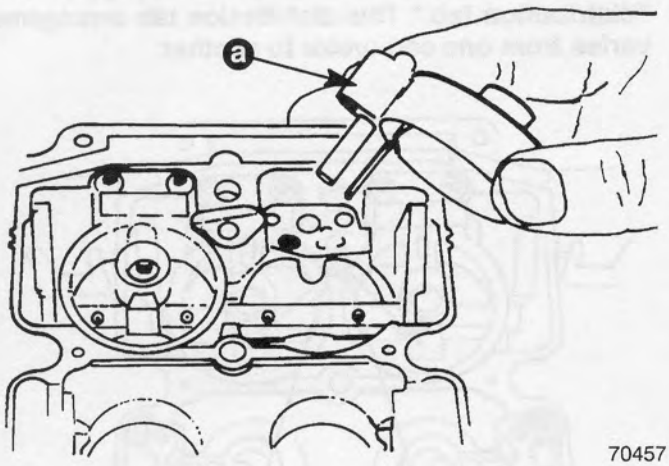
9. Position the secondary venturi cluster gaskets.



70458

a - Gasket, Secondary Venturi Cluster

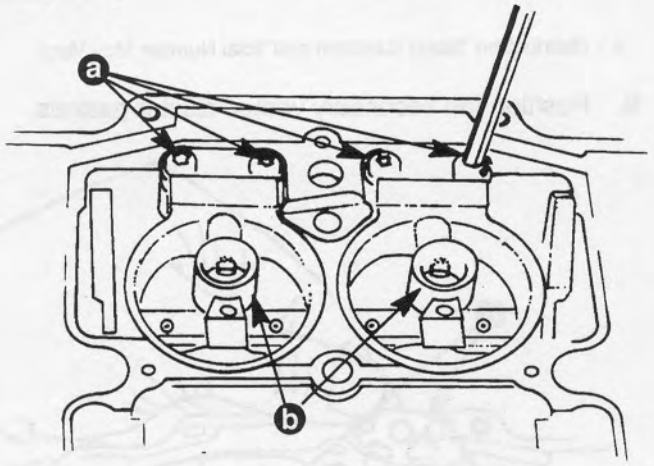
10. Install the secondary venturi clusters.



70457

a - Secondary Venturi Cluster

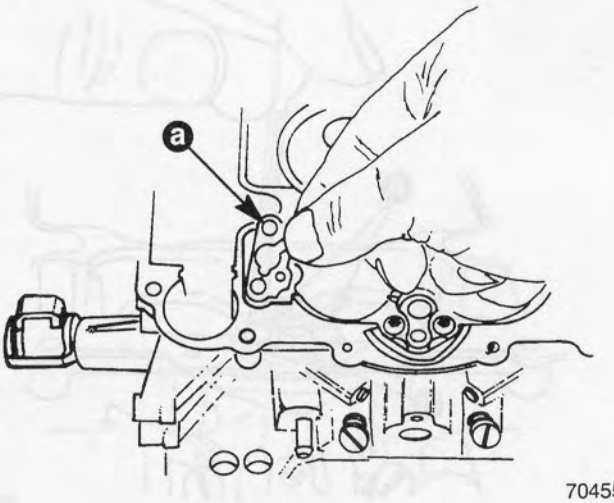
11. Secure each cluster with two screws. Tighten securely.



70456

a - Screws (Two Each Side)
b - Secondary Venturi Cluster(s)

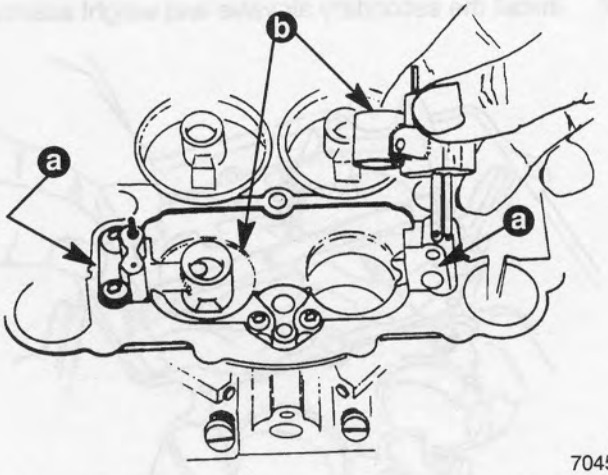
12. Position the primary venturi cluster gaskets.



70455

a - Gasket, Primary Venturi Cluster

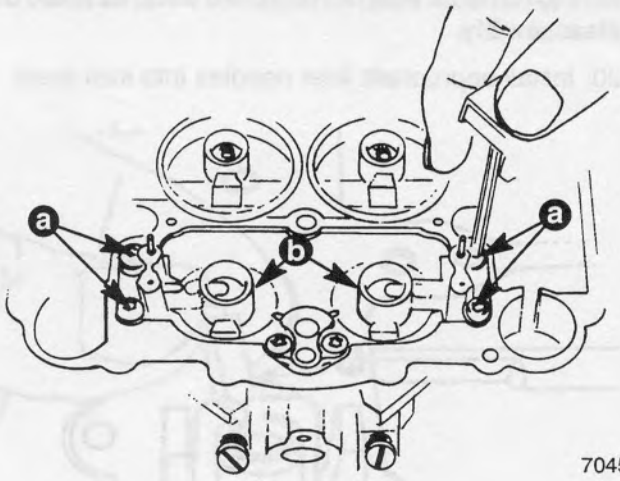
13. Install the primary venturi clusters.



70454

a - Gasket, Primary Venturi Cluster (One Not Visible in This View)
b - Primary Venturi Cluster

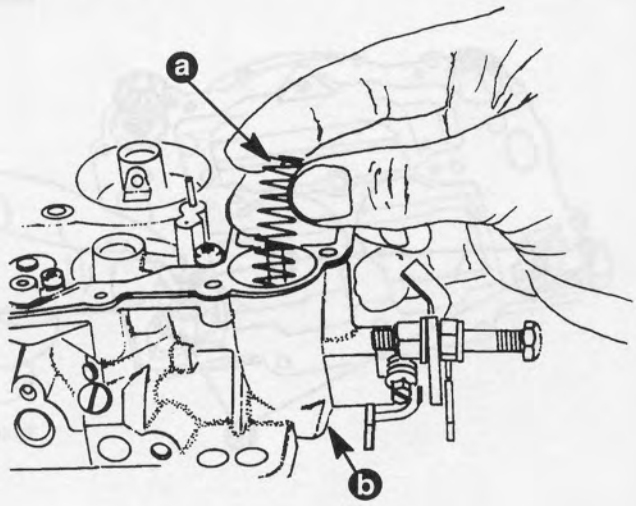
14. Secure each cluster with two screws. Tighten securely.



70453

a - Screws (Two Each Side)
b - Primary Venturi Cluster(s)

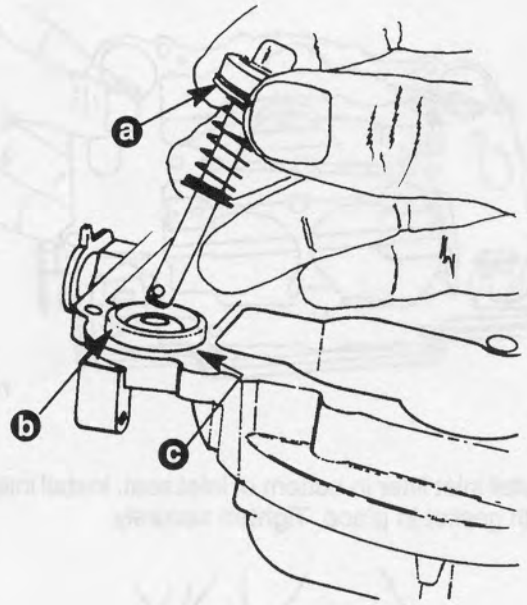
15. Install the accelerator pump spring into bottom half of carburetor.



70451

a - Accelerator Pump Spring
b - Carburetor Bottom

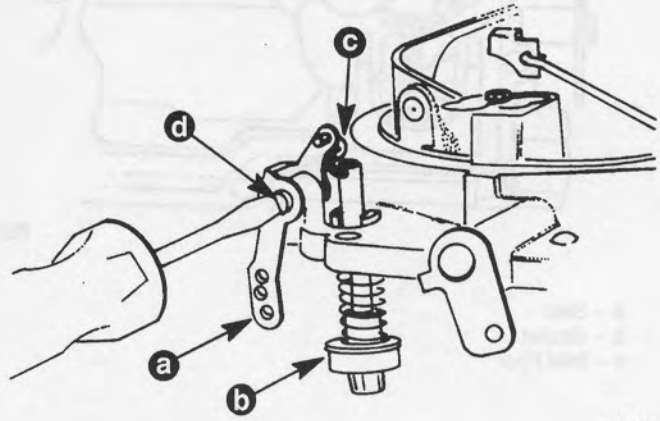
16. Install accelerator pump in top of carburetor housing, after placing washer and guide in position.



70450

a - Accelerator Pump
b - Plunger Guide
c - Plunger Washer (Not Visible in This View)

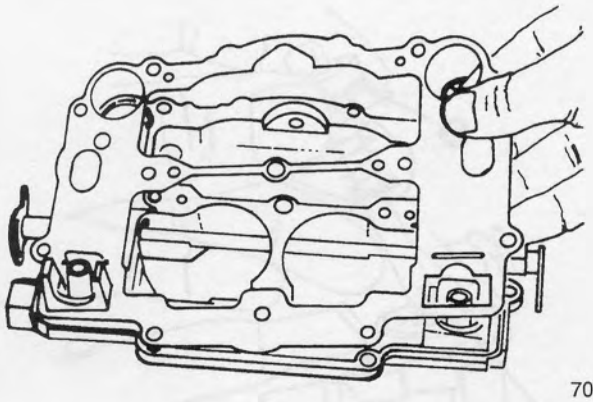
17. Connect accelerator pump lever to pump rod using the S-link. Secure pump lever with pivot screw. Tighten securely. Check to ensure lever actuates the accelerator pump.



70449

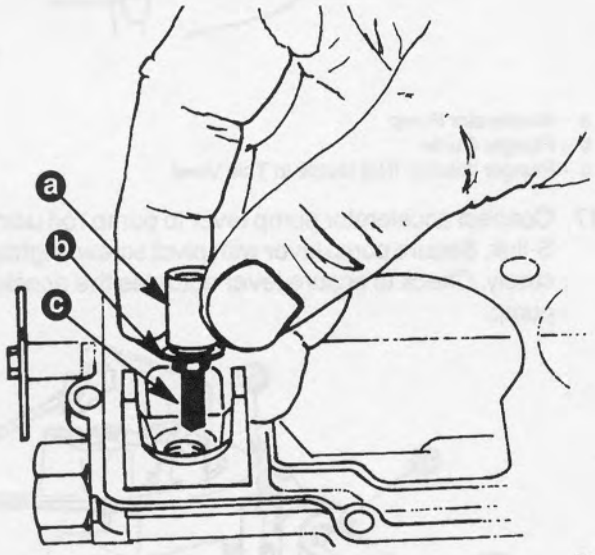
a - Accelerator Pump Lever
b - Accelerator Pump
c - S-Link
d - Retaining Screw

18. Install gasket on top of carburetor.



70448

19. Install inlet filter in bottom of inlet seat. Install inlet seat with gasket in place. Tighten securely.

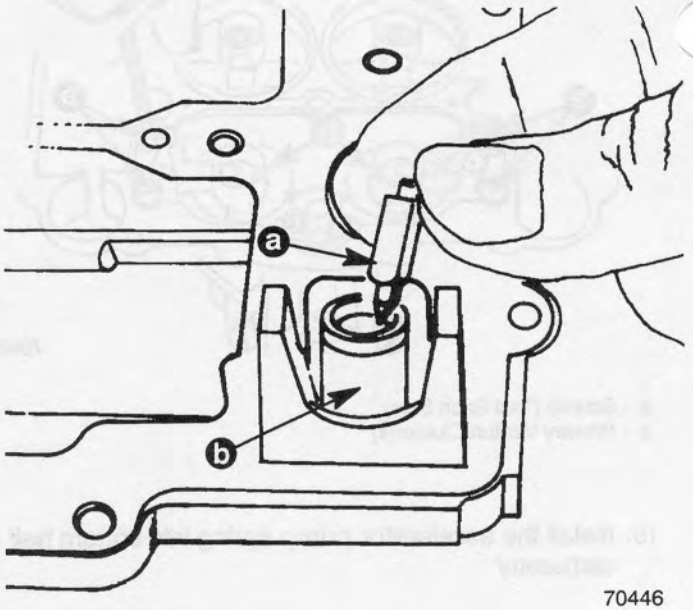


70447

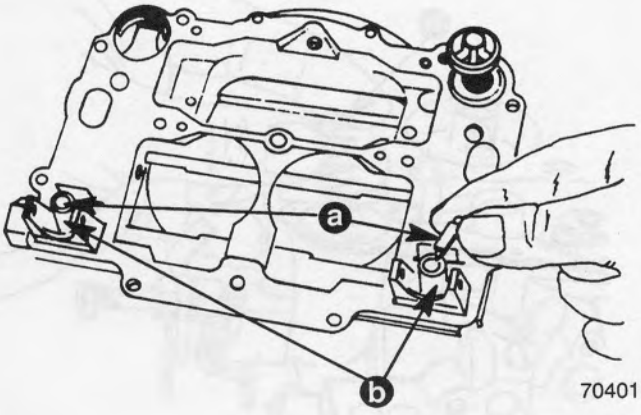
a - Seat
b - Gasket
c - Inlet Filter

IMPORTANT: If using existing needles and seats, be sure to reinstall them as matched sets, as noted during disassembly.

20. Install appropriate inlet needles into inlet seats.



70446

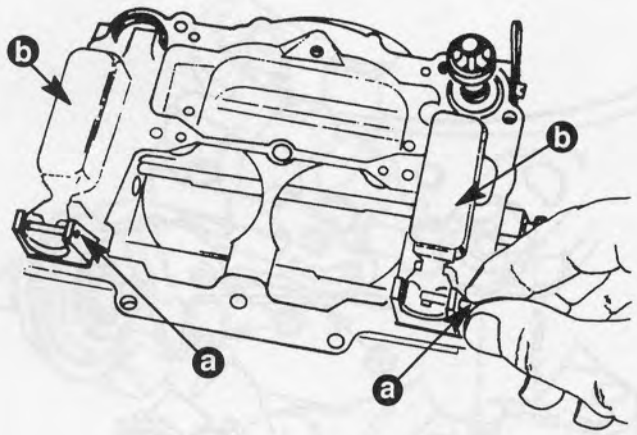


70401

a - Inlet Needle(s)
b - Seat(s)

IMPORTANT: If using existing floats, be sure to reinstall them on the same side as removed.

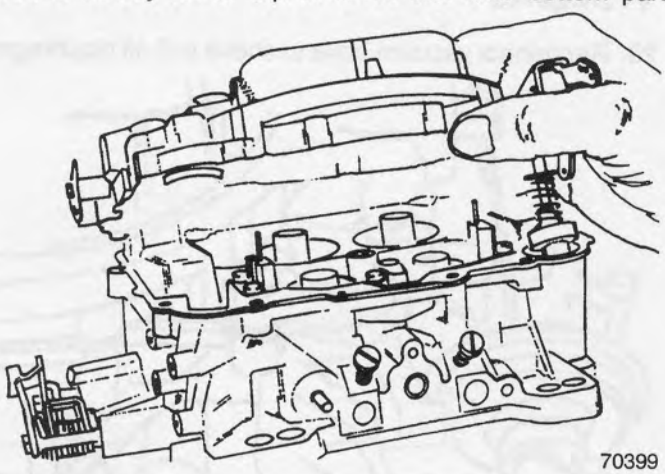
21. Install floats using hinge pins.



70400

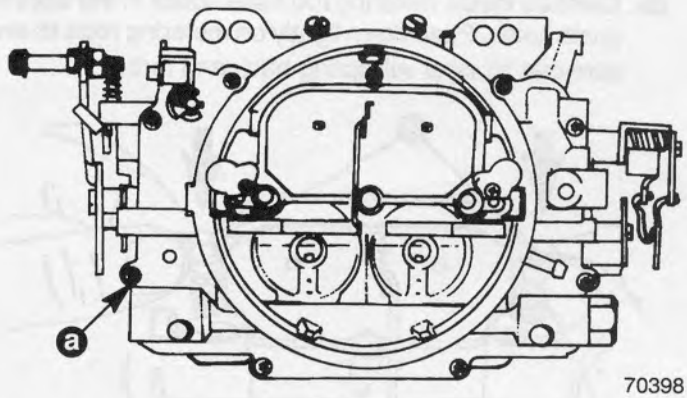
a - Pin(s)
b - Float(s)

22. Carefully lower top of carburetor onto bottom part.



70399

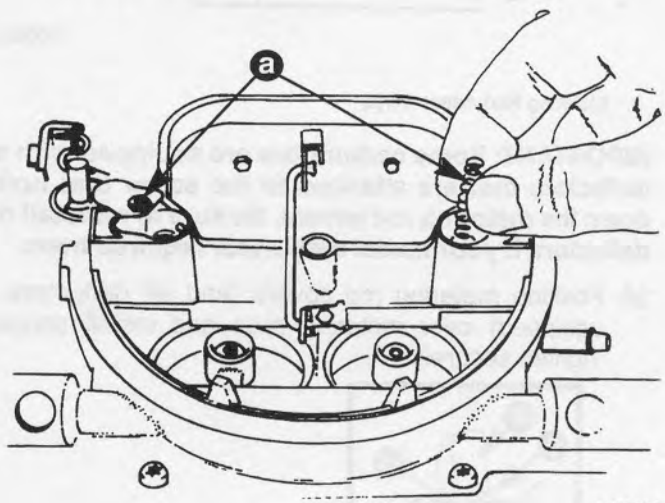
23. Ensure gasket is properly positioned between the two parts and secure the top to bottom with screws (nine total). Tighten securely.



70398

a - Screw(s)

24. Install metering rod springs into each metering rod hole. Be certain to install the appropriate color spring (refer to "Specifications").

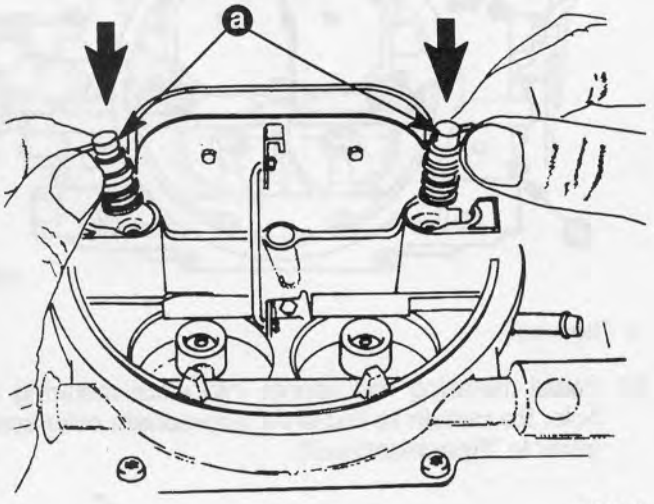


70397

a - Spring(s)

IMPORTANT: If using existing metering rods, be sure that they are reinstalled in the same side from which removed during disassembly.

25. Carefully install metering rod assemblies in the appropriate holes. Push down lightly on metering rods to ensure that plunger will spring back and forth.

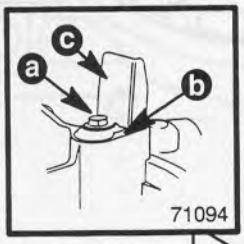


70396

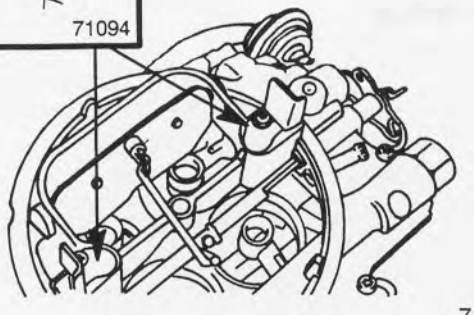
a - Metering Rod Assembly(s)

IMPORTANT: Some carburetors are equipped with air deflectors that are attached to the screw that holds down the metering rod covers. Be sure to reinstall the deflectors if your model carburetor requires them.

26. Position metering rod covers (and air deflectors, if equipped) over metering rods and install screws. Tighten securely.



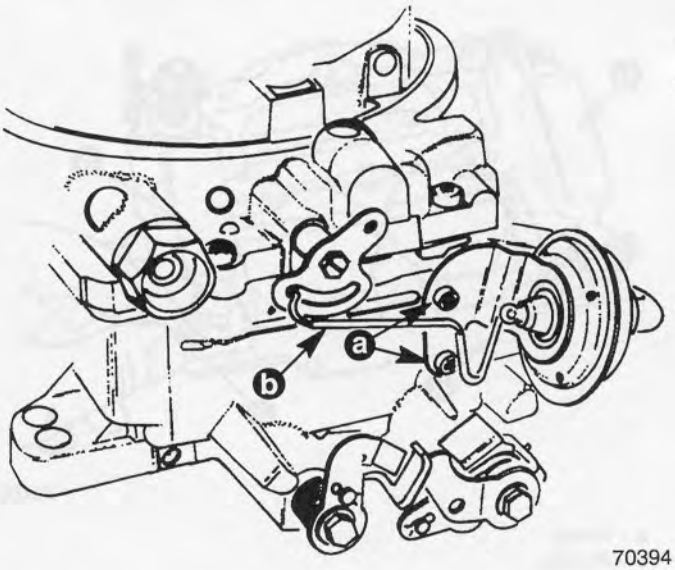
71094



71095

a - Screws
b - Metering Rod Cover(s)
c - Air Deflectors (if So Equipped)

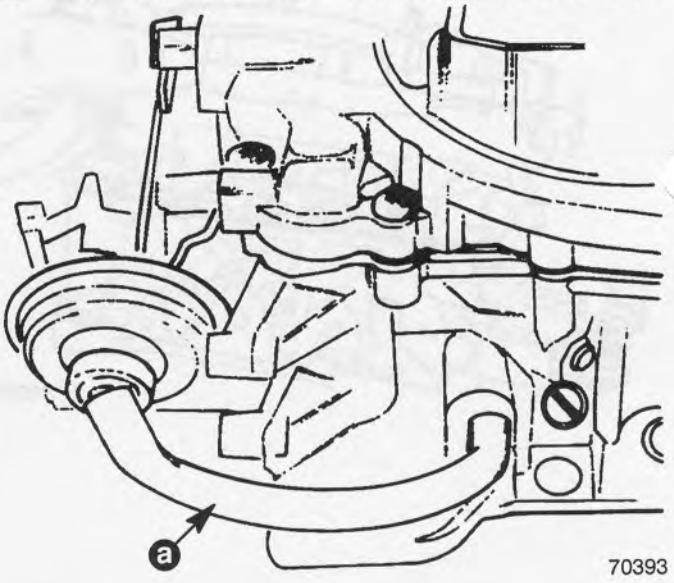
27. Reconnect choke pull-off linkage to carburetor. Reinstall choke pull-off diaphragm. Secure with two screws and tighten securely.



70394

a - Screw(s)
b - Linkage Rod

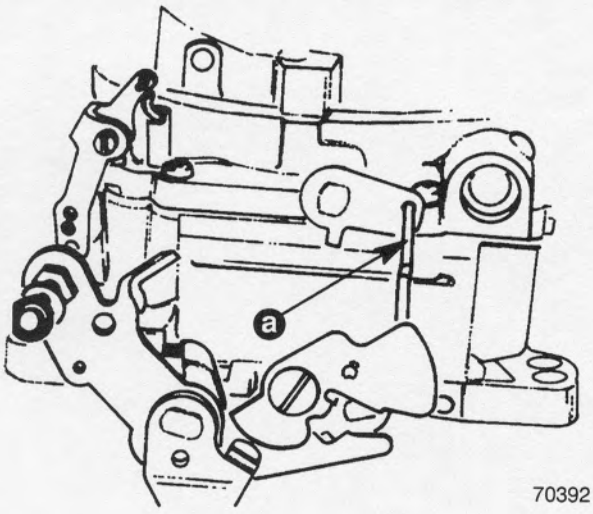
28. Reconnect vacuum hose to choke pull-off diaphragm.



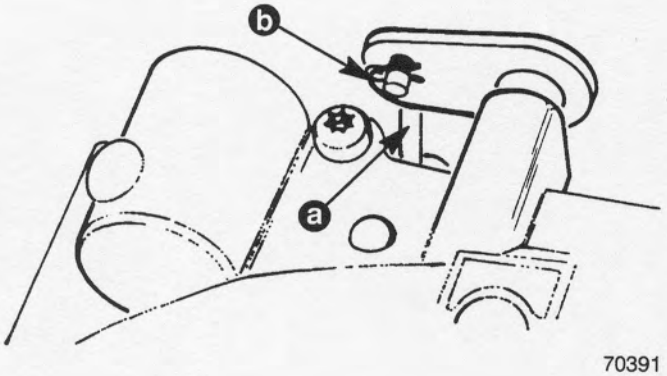
70393

a - Vacuum Hose

29. Reconnect choke plate linkage. Secure with wire clip.



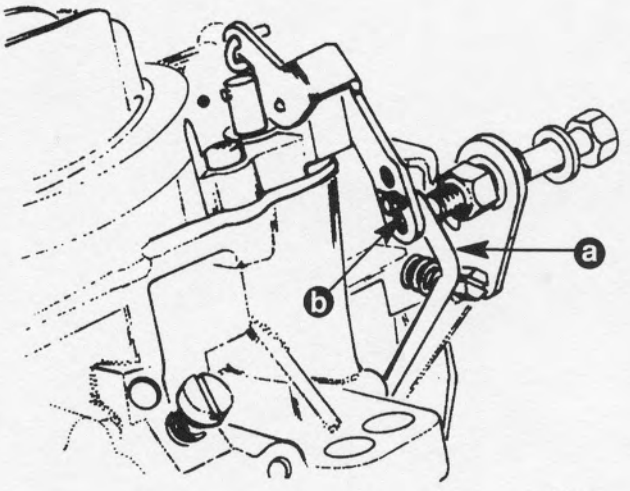
70392



70391

a - Choke Plate Linkage Rod
b - Wire Clip

30. Reconnect accelerator pump linkage rod to hole in accelerator pump lever where originally connected or refer to "Important Service Information" in this section for information regarding adjustment. Accelerator pump linkage adjustment should be checked at this time; refer to Adjustment - "Accelerator Pump" as previously outlined. Secure using wire clip.

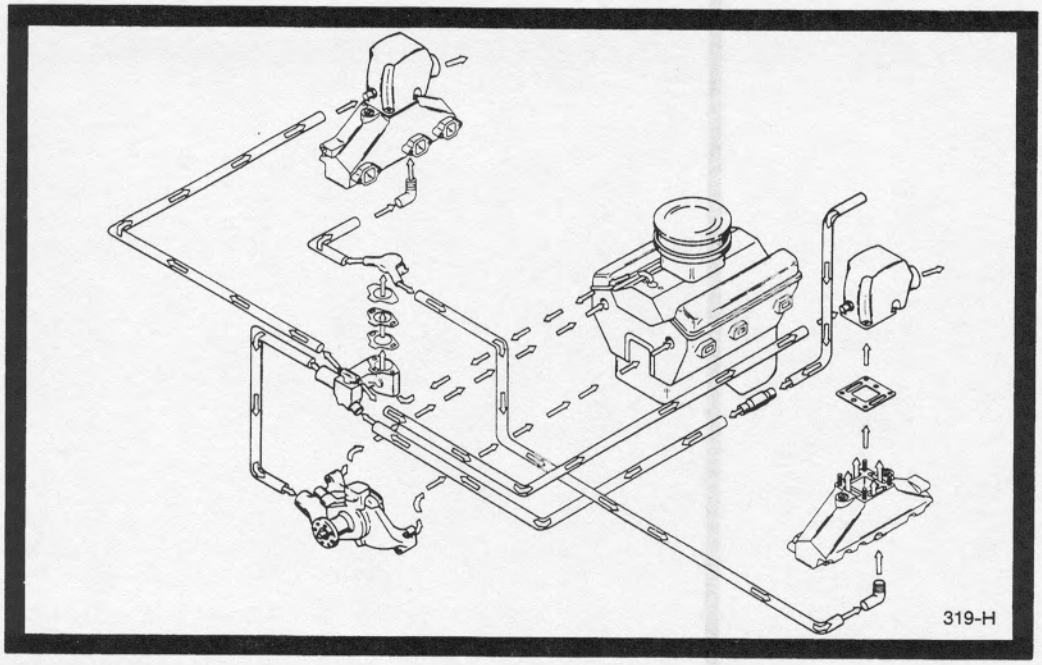


70390

a - Accelerator Pump Linkage Rod
b - Wire Clip

31. Refer to "Installation" and install carburetor.

STANDARD COOLING



6

A

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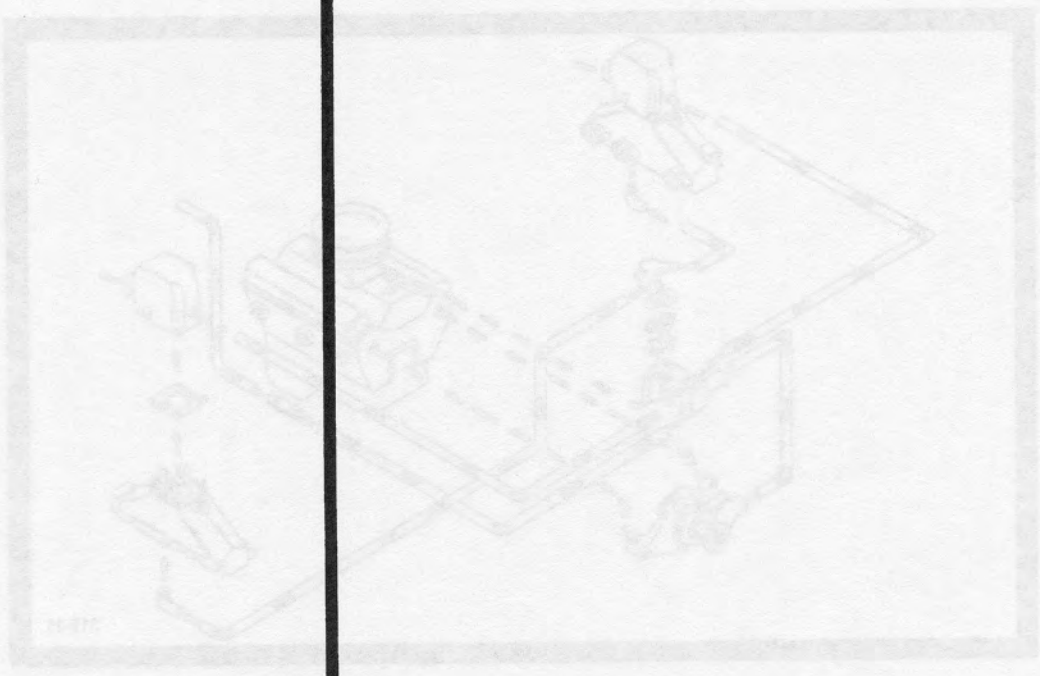
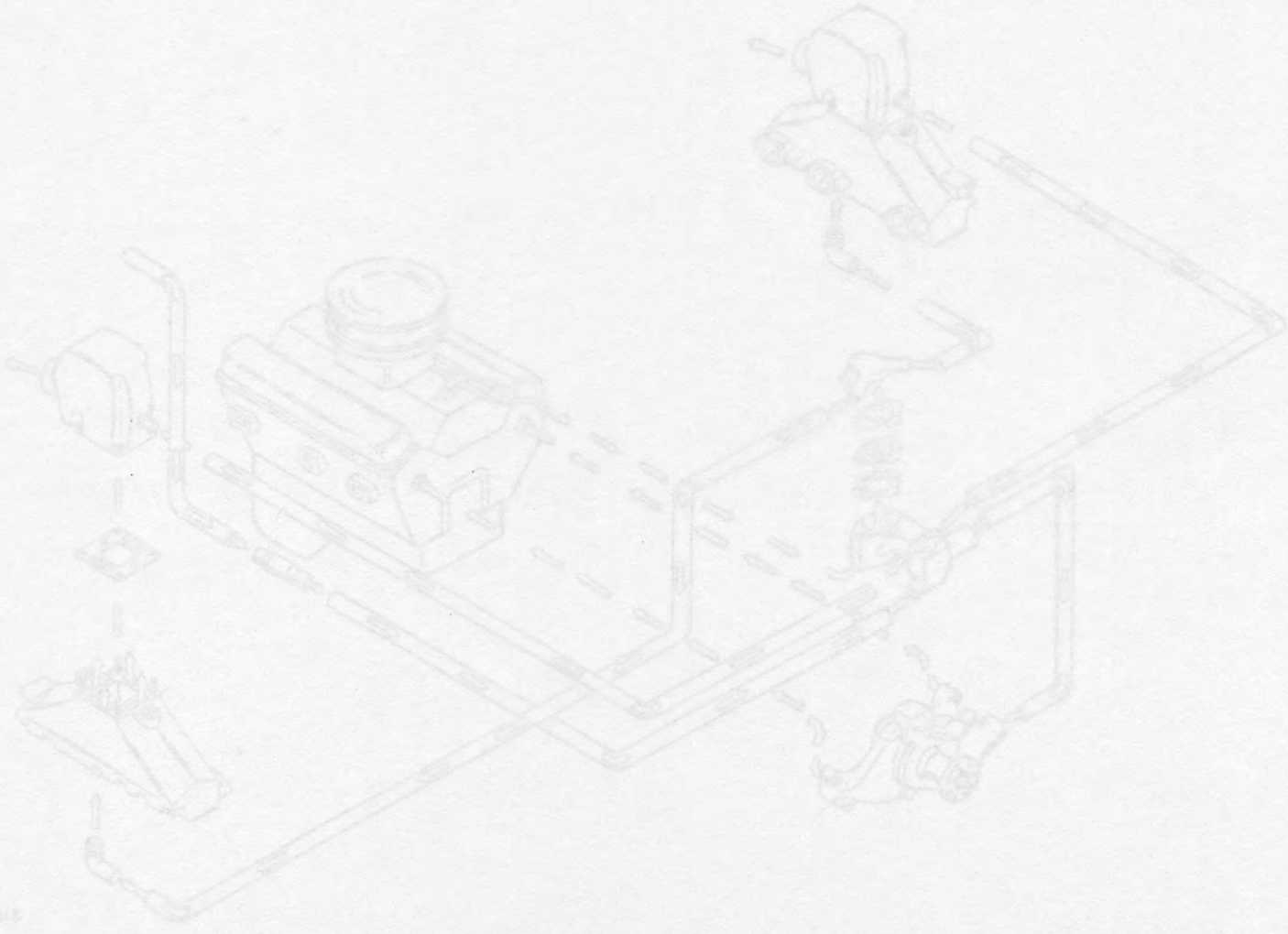


Torque Specifications

Fastener Location	Lbs. (N.m)
Thermostat Housing Cover Retaining Bolts	30 Lbs. Ft. (40.5 N.m)
Hose Clamps	Securely
Circulating Pump Bolts	30 Lbs. Ft. (40.5 N.m)

Sealants

92-34227	Quicksilver Perfect Seal



Cooling System

Standard Cooling

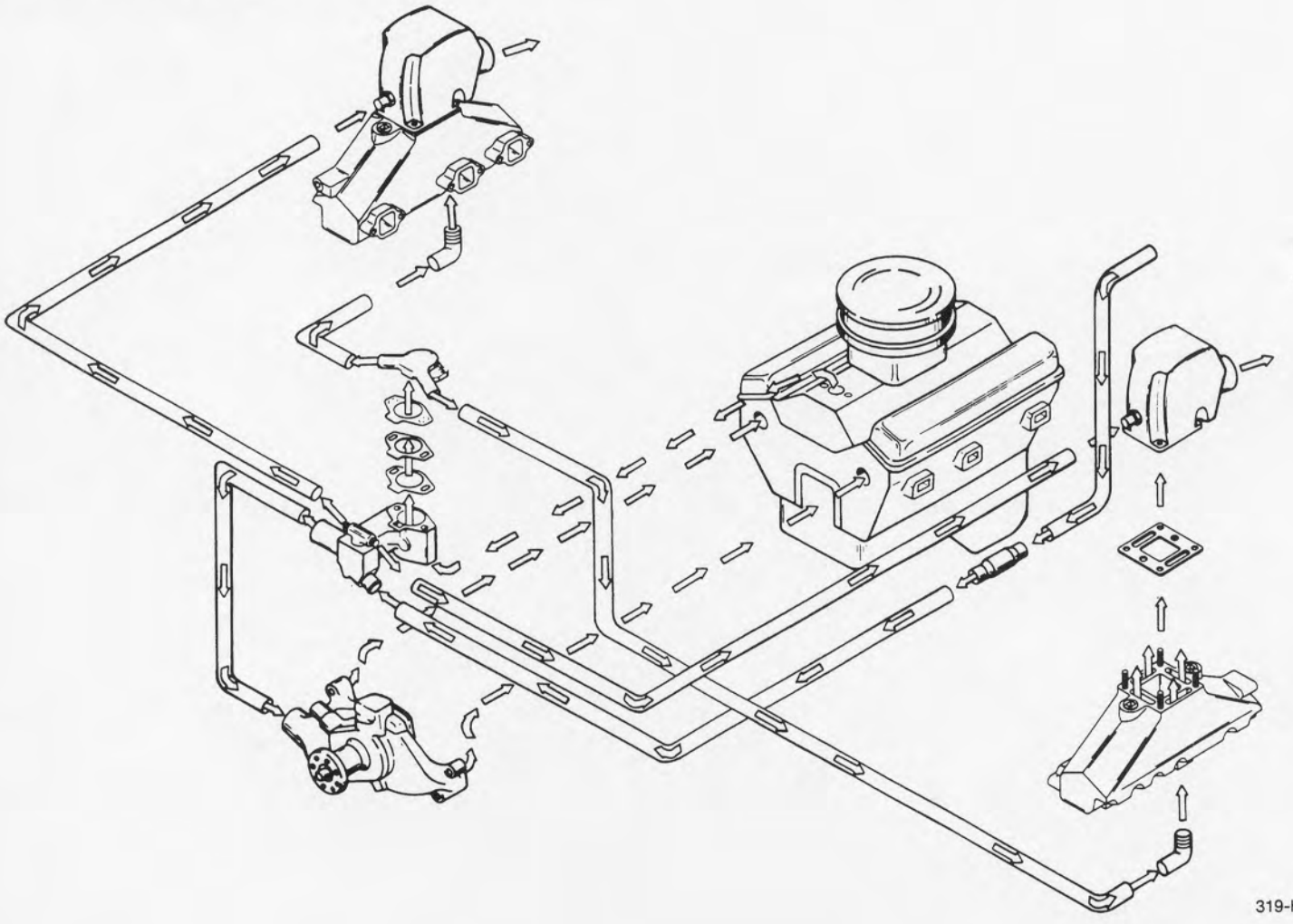
MerCruiser engines with standard cooling systems use seawater (water in which the boat is being operated) to remove the heat given off by the engine.

The seawater is pumped to the cooling system by means of an impeller type pickup pump (located in the drive unit) which picks up seawater and delivers it to the centrifugal pump (located on the front of the cylinder block). On some models, seawater may be pumped through an oil cooler before going to the circulating pump. The pump then circulates the seawater through the block, head(s) and manifold(s), removing the heat given off by these parts as it passes.

After passing through the engine, the seawater is pumped into the exhaust elbow, where it mixes with the exhaust gases, and is expelled overboard.

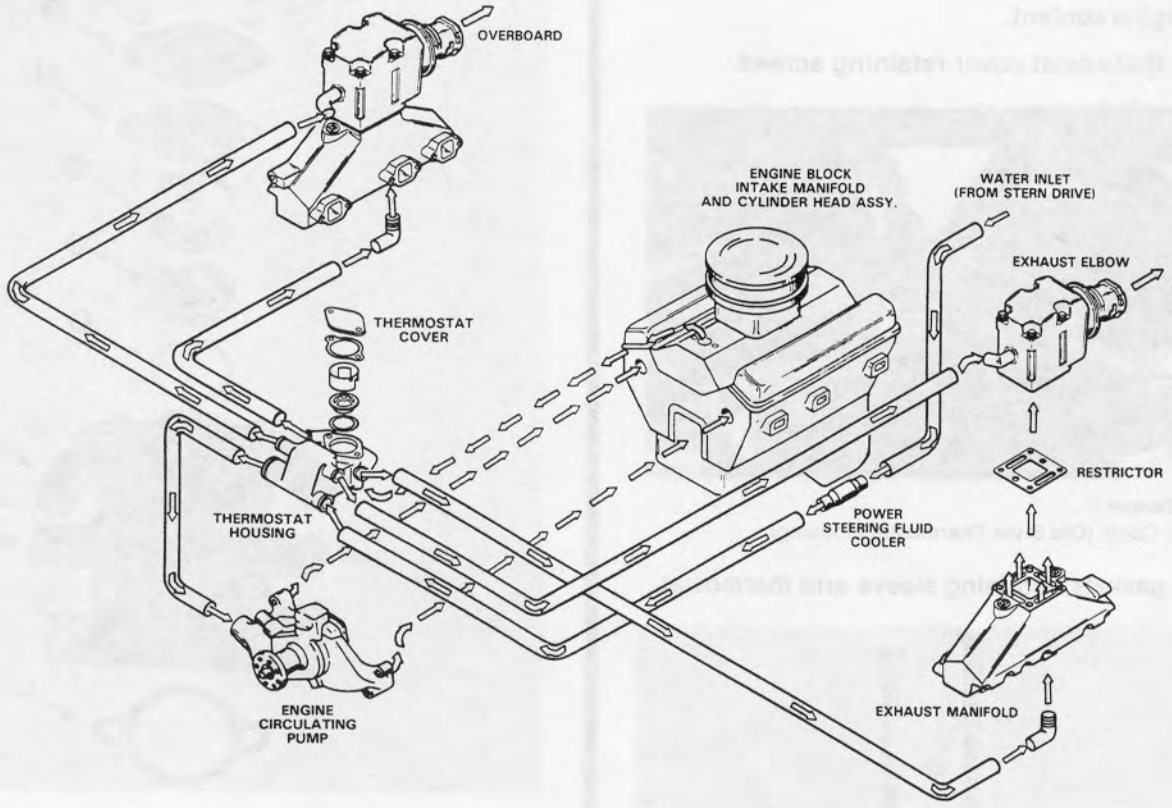
A thermostatic heat control, which controls circulation of the seawater, also is incorporated into the system, for fast engine warmup and controlled operating temperature.

Flow Diagram (Tee Fitting Style Thermostat Housing)

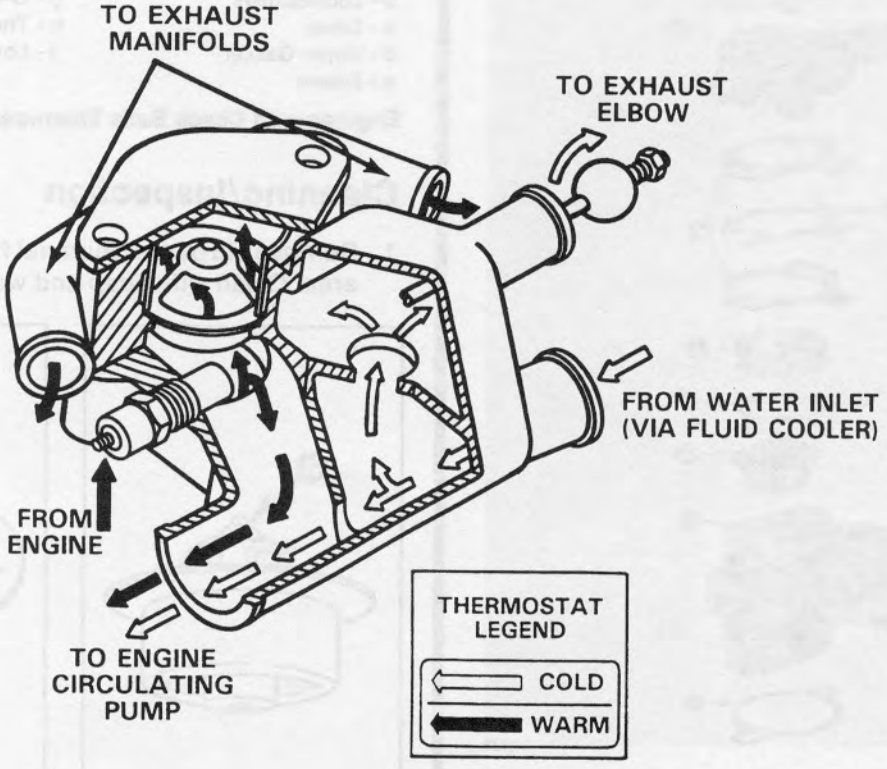


319-H

Flow Diagram (Check Ball Style Thermostat Housing)



22381

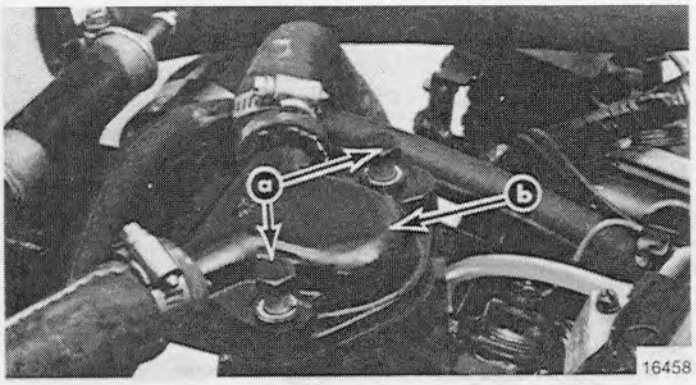


22380

Thermostat

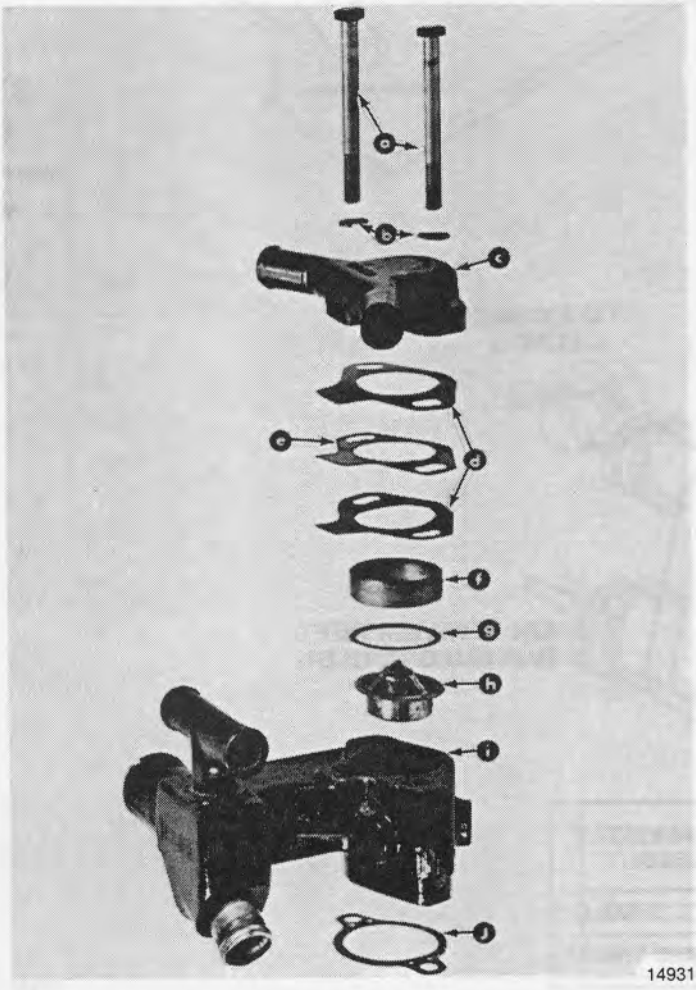
Removal

1. Drain engine coolant.
2. Remove thermostat cover retaining screws.



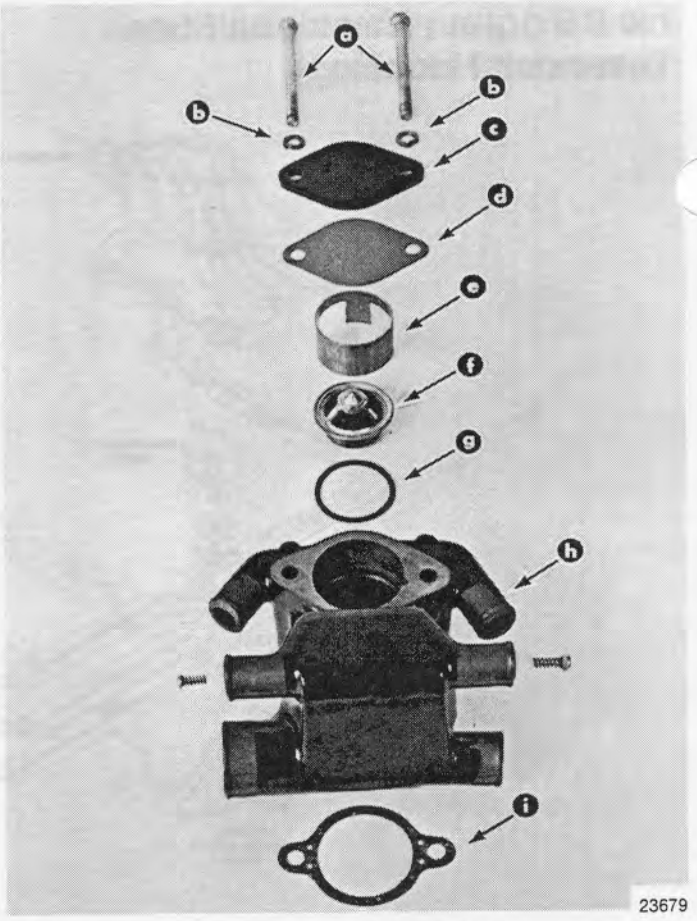
a - Retaining Screws
b - Thermostat Cover (Old Style Thermostat Housing)

3. Remove gaskets, retaining sleeve and thermostat.



a - Screws
b - Lockwashers
c - Thermostat Housing Cover
d - Upper Gaskets
e - Stainless Steel Plate
f - Thermostat
g - Cork Gasket
h - Sleeve (Turned-In Lip Must Be Up)
i - Thermostat Housing
j - Lower Gasket

Engines with Tee-Fitting/Check Balls Thermostat Housing

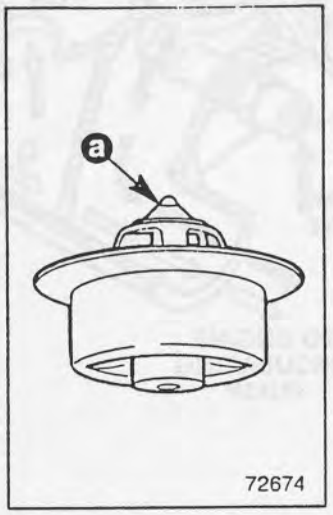


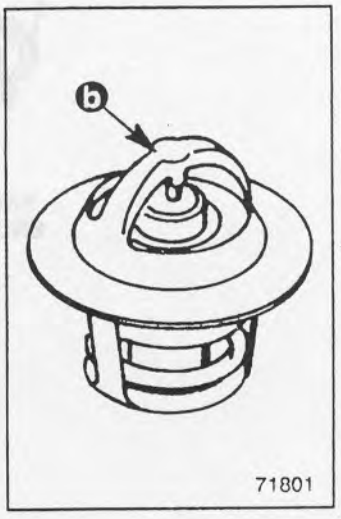
a - Screws
b - Lockwashers
c - Cover
d - Upper Gasket
e - Sleeve
f - Thermostat
g - O-Ring
h - Thermostat Housing
i - Lower Gasket

Engines with Check Balls Thermostat Housing

Cleaning/Inspection

1. Remove old gasket material from thermostat flange area. Clean with soap and water.





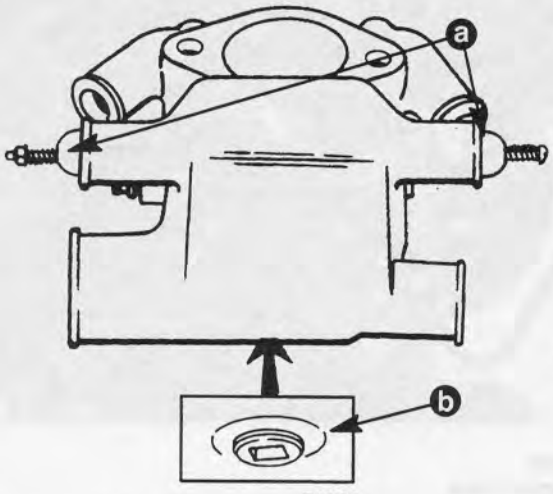
a - Brass Thermostat
b - Stainless Steel Thermostat

2. Inspect for corrosion or other visible damage.

V6 and V8 Thermostat Housings

CHANGES TO THERMOSTAT HOUSING ON RAW WATER COOLED ENGINES

Production has been using a thermostat housing that doesn't use the nylon check balls. This new housing has internal changes to it so the nylon check balls aren't needed any longer. DO NOT install the check balls in the new housing. Refer to Figures 1 and 2 for identification.

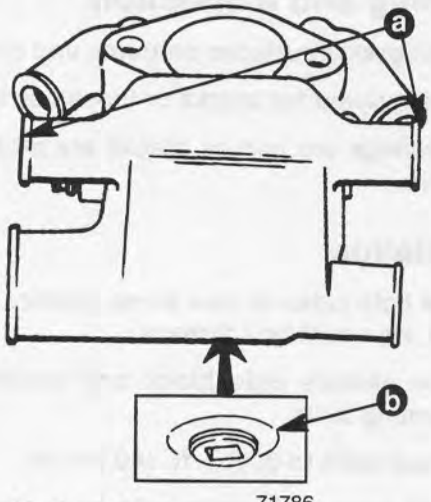


71784

71786

a - Pressure Relief Nylon Balls - Holes in Casting is Chamfered
b - Pipe Plug - Located on Bottom of Casting

With Check Balls



71785

71786

a - Holes are Not Chamfered
b - Early Production had this Pipe Plug. Later Production Does Not.

Without Check Balls

Thermostat Housing WITH Check Balls. Must be used on all V6 engines that use an R, MR or Alpha One stern drives with the smaller water pump impeller.

Thermostat Housing WITHOUT Check Balls. Can be used on all V6 engines that use Alpha One Gen II stern drive with the "floppy vane" water pump impeller. Also, it can be used on any V8 engine that uses a belt driven seawater pickup pump which includes all Bravo and inboard engines.

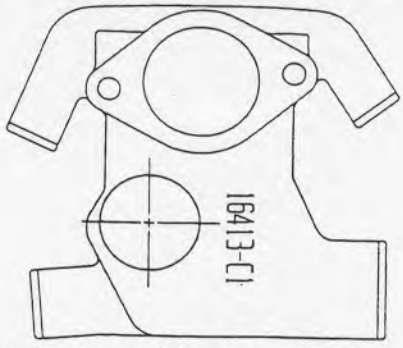
INSPECTION

The by-pass hole in the 16413A9 housing can be checked if needed. Early production housings had a plug that can be removed to inspect this hole.

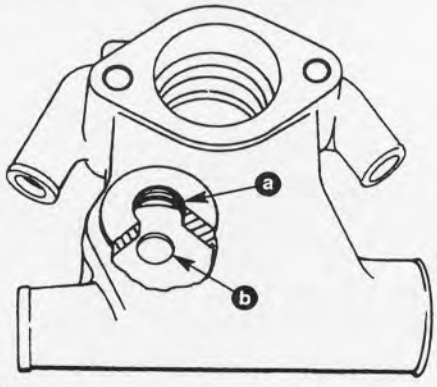
Later production housings don't have this plug. A hole will have to be drilled thru the outer wall so that you can inspect the inner hole if needed.

NOTE: Before drilling, read instructions completely.

1. Turn housing upside down and mark it for center punching.
2. Center punch then drill hole to specified size so it can be taped and plugged after inspection. US: 23/32 inch (metric: 18.5 mm).
3. By-pass hole ID must be 1/2 inch ± 1/32 (12.5 mm ± 1.0).
4. If hole is under size, water hoses may expand when thermostat is closed because water can't flow out the by-pass fast enough. If hole is over size, engine may overheat at idle or low RPM because too much water is flowing out of by-pass.
5. After inspection, tap hole. US: 1/2-14 NPT (metric: M20x1.5).
6. Cast iron, brass or stainless steel plug must be used. Order P/N 22-37372 from Quicksilver Parts Department which is 1/2-14 NPT cast iron. (Metric: M20x1.5 plug and A20 Sealing Washer, get from local source.)
7. Apply sealant to threads before installing.



Marking Housing for Drilling Location



a - Drilled Hole
b - 1/2 inch ± 1/32 (12.5 mm ± 1.0)

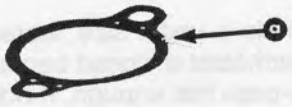
Measure By-Pass Hole

Testing

1. Use a thermostat tester for checking opening and closing of thermostat.
2. Follow testers instructions for use and test thermostat to specifications.
3. If not within specifications replace.

Installation

1. Clean all gasket surfaces.
2. Coat new thermostat housing lower gasket both sides with Perfect Seal and install onto intake manifold.



14931

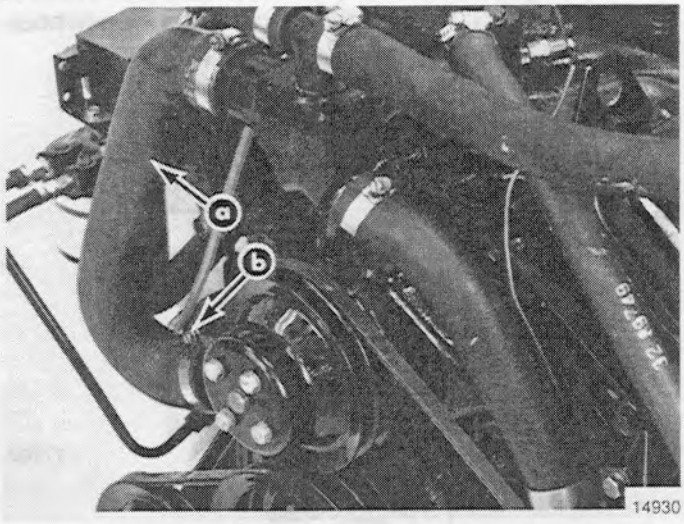
a - Thermostat Housing Lower Gasket

3. Install thermostat housing, sleeve, thermostat, gaskets and housing cover in sequence as shown on page 4.
4. Torque cover bolts to 30 lbs. ft. (40.5 N.m).
5. Reconnect hoses. Tighten clamps securely.

Circulating Pump

Removal

1. Drain coolant.
2. Loosen pump attaching bolts.
3. Remove hose from pump.



14930

a - Hose
b - Remove Here

4. Remove pump pulleys.
5. Remove pump attaching bolts and pump.

Cleaning and Inspection

1. Clean gasket surfaces on pump and block.
2. Inspect pump for cracks or loose bearings.
3. If bearings are bad or cracks are present replace pump.

Installation

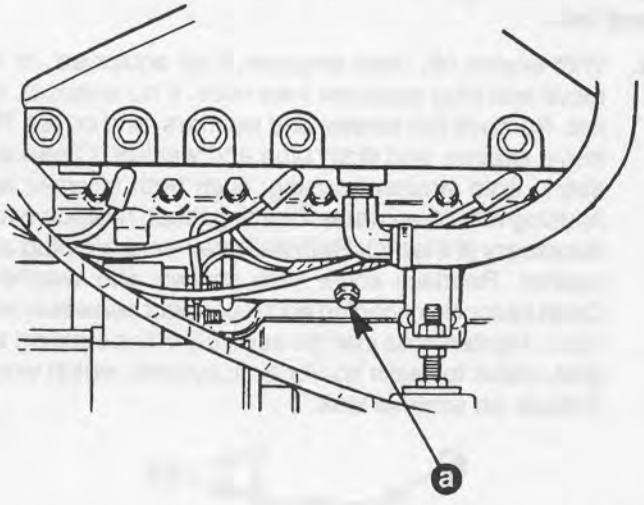
1. Coat both sides of new pump gaskets with Perfect Seal, also coat bolt threads.
2. Place gaskets onto block and install pump and mounting bolts.
3. Torque bolts to 30 lbs. ft. (40.7 N.m).
4. Install hose and secure with hose clamp. Tighten securely.
5. Install pump pulleys and bolts. Tighten securely.
6. Close all drains and fill cooling system.

Draining Cooling System

Standard Cooling

IMPORTANT: When draining cooling system, boat MUST BE positioned so that engine is level, or cooling system will not drain completely. It also is advisable to insert a piece of wire into drain holes (remove petcocks) to ensure that sand, silt, rust or other foreign material is not obstructing the drain holes. If the engine is not completely drained for winter storage, trapped water may freeze and cause severe damage to engine.

1. If possible, place a container under drains to prevent water from draining into boat.
2. Remove drain plug from each exhaust manifold and exhaust elbow (port and starboard) and open cylinder block petcock on each side of block.



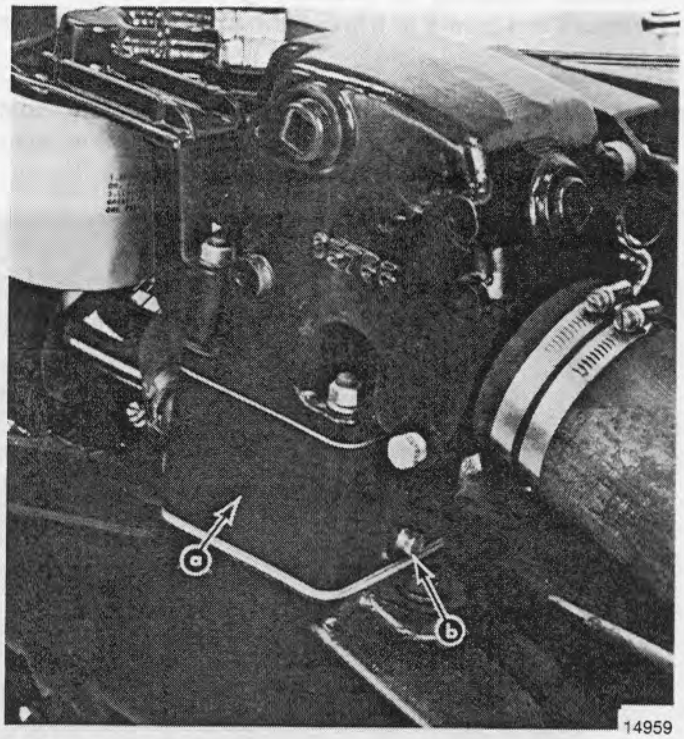
72993

a - Drain Plug (Port and Starboard)

Starboard Side Shown (Port Similar)

a - Exhaust Elbow Drain Plug (except Stainless Steel)
b - Exhaust Manifold Drain
c - Cylinder Block Drain

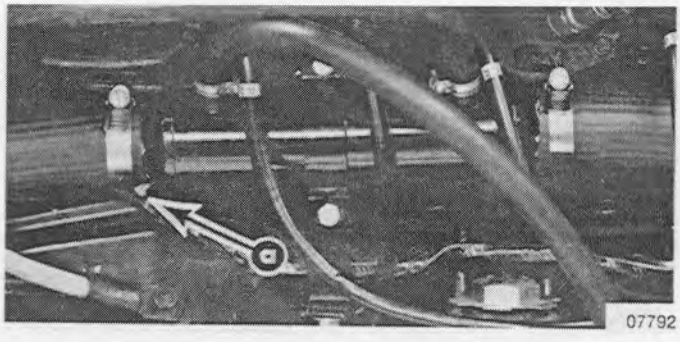
3. If engine is equipped with exhaust elbow risers (located under exhaust elbows) remove drain plug from front of each riser.



14959

a- Exhaust Elbow Riser
b - Drain Plug

4A. **EARLIER STYLE:** On engines equipped with Power Steering, remove drain plug (if equipped) from bottom-aft end of Power Steering oil cooler or remove hose and lower to drain. Later style has no drain plug.



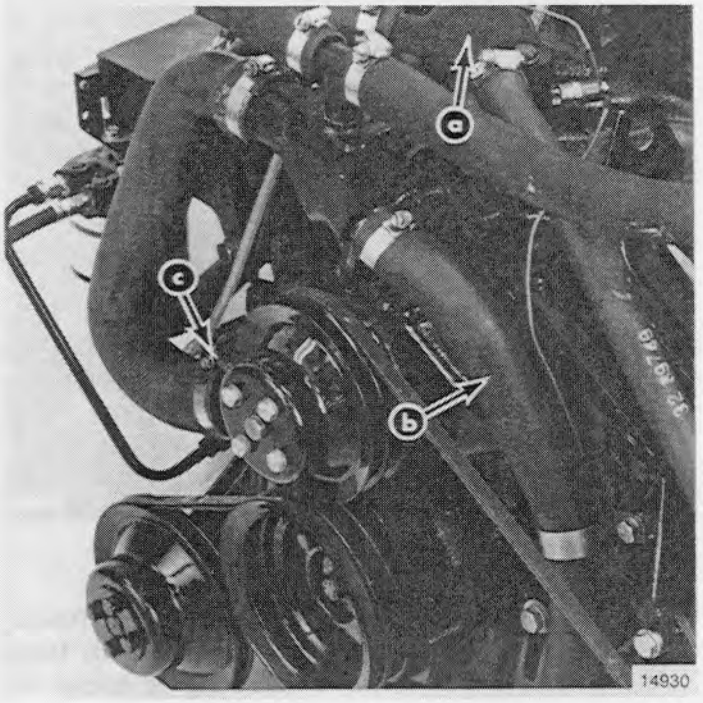
07792

a - Power Steering Oil Cooler Drain Plug (if so Equipped)

4B. **LATER STYLE:** Disconnect hose from aft end of power steering cooler, and bend hose down to allow water to drain.

5. On engines without Power Steering, disconnect water inlet hose from thermostat housing and lower the hose to allow water to drain. Disconnect thermostat housing to circulating pump hose from circulating pump and lower the hose to allow water to drain.

6. After cooling system has drained completely, coat threads of drain plugs with Perfect Seal and reinstall. Close petcocks and reconnect hoses.



a - Thermostat Housing
b - Water Inlet Hose
c - Circulating Pump Hose

Check/Clean Seawater Strainer

NOTICE

Refer to manufacturer's instructions for information on checking and cleaning of other than Quicksilver Seawater Strainer.

1. Visually inspect seawater strainer through glass top.

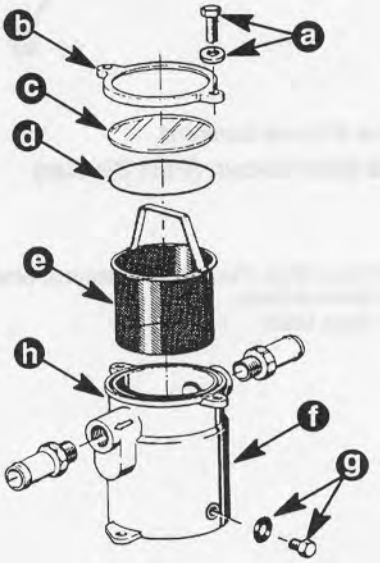
⚠ WARNING

When cleaning seawater strainer, close seacock, if so equipped. If boat is not equipped with a seacock, remove and plug seawater inlet hose to prevent a siphoning action that may occur, allowing seawater to flow from the drain holes or removed hoses.

⚠ CAUTION

Do not over-tighten cover screws or cover will warp and leak.

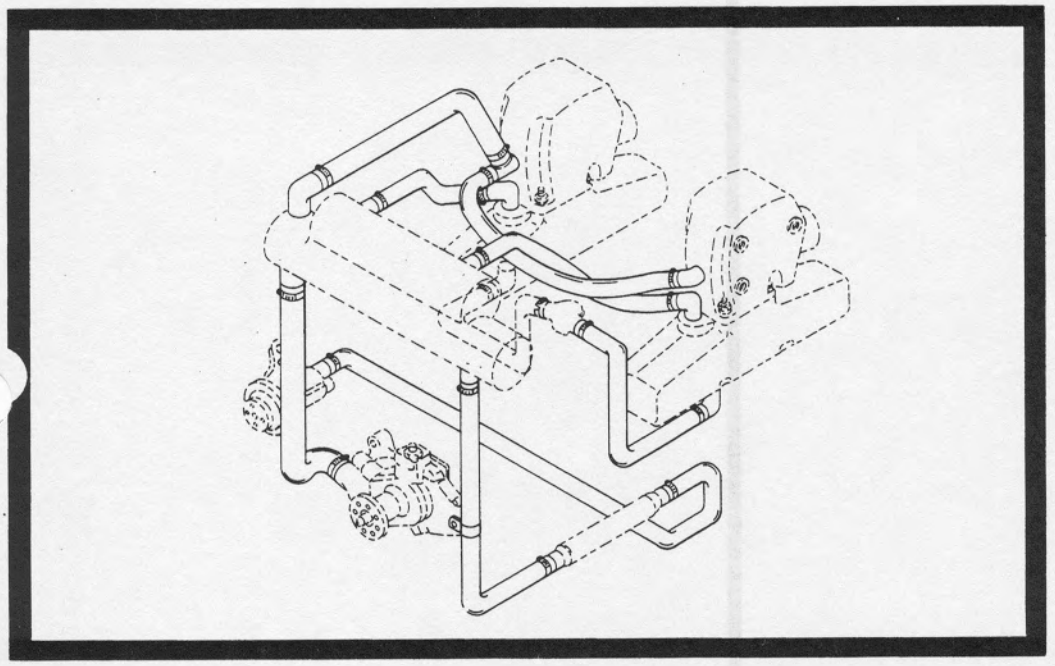
2. With engine off, close seacock, if so equipped, or remove and plug seawater inlet hose, if no seacock exists. Remove two screws and washers, and cover. Remove strainer, and drain plug and washer. Clean any debris from strainer housing; flush both strainer and housing with clean water. Check gasket; replace when necessary (if it leaks). Reinstall strainer, drain plug and washer. Reattach cover with screws and washers. Open seacock, or unplug and reconnect seawater inlet hose. Tighten hose clamps securely. After starting engine, check for leaks and/or air in system, which would indicate an external leak.



a - Screws and Washers
b - Cover
c - Glass
d - O-Ring
e - Strainer
f - Housing
g - Drain Plug and Sealing Washer
h - Gasket

Quicksilver Seawater Strainer Shown

CLOSED COOLING



6

B

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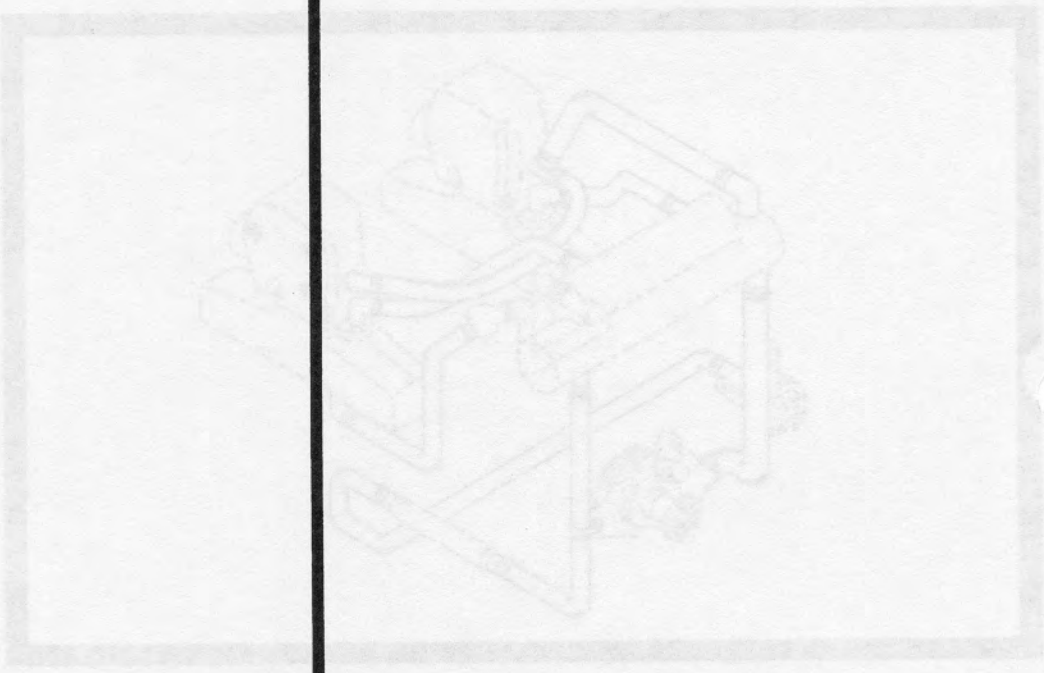


Torque Specifications

Fastener Location	Lbs. (N.m)
Water Pump Cover Bolts	10 Lbs. Ft. (13.5 N.m)
Water Pump Mounting Bracket Clamp Bolt	20 Lbs. Ft. (27 N.m)
Heat Exchanger End Cover Attaching Screws	36-72 Lbs. In. (4.1 - 8.1 N.m)

Sealants/Coolant

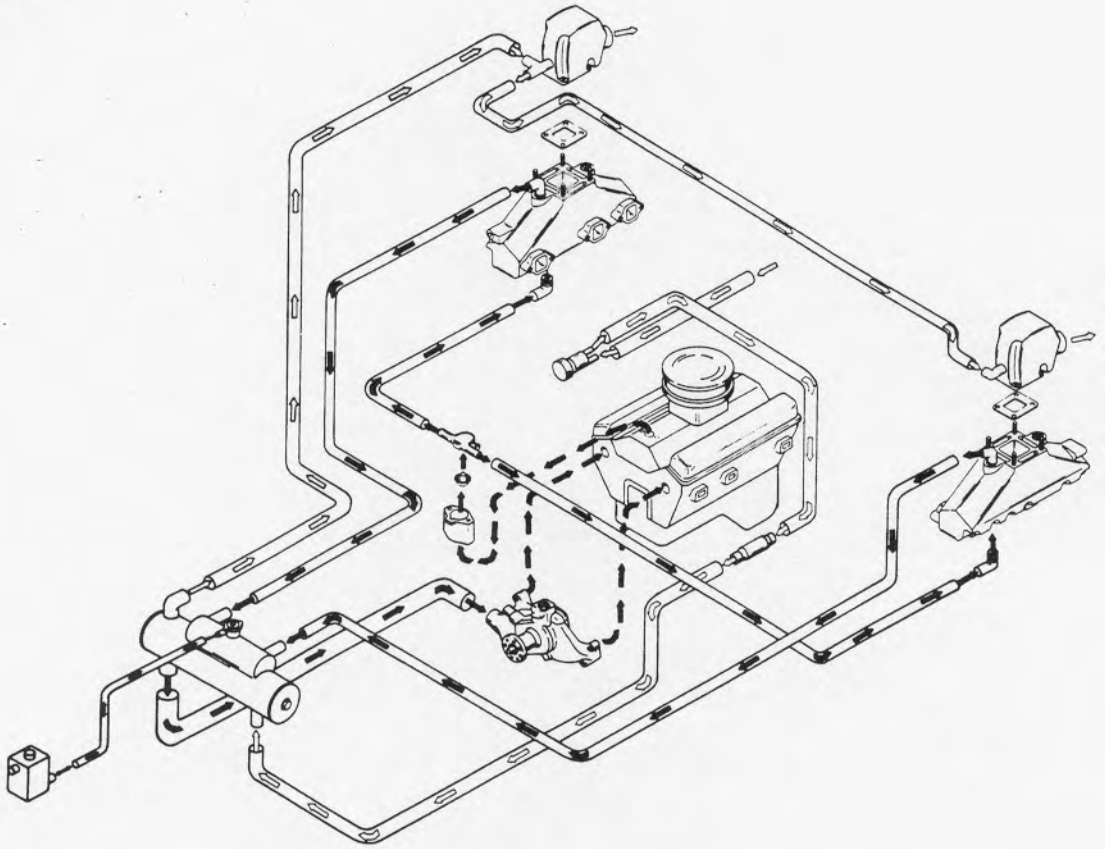
92-34227	Quicksilver Ethylene Glycol

Closed Cooling

MerCruiser engines with Closed Cooling incorporate a heat exchanger which is a device used to transfer heat from one body of water to another without the 2 ever coming in direct contact or mixing. This enables the cooling system to be separated into 2 individual sections (the fresh water section and the seawater section), thus allowing the engine to be cooled with fresh (uncontaminated) water which, in turn, is cooled in the heat exchanger by the seawater. In this way, engine cooling is achieved without the seawater ever contacting the water passages within the engine, thereby preventing corrosion and the accumulation of deposits and debris that might otherwise occur. This system can greatly increase engine life and provide better engine efficiency.

The fresh water section (or closed section) is filled with a coolant such as a solution of ethylene glycol (anti-freeze) and water or a solution of rust inhibitor and water. A centrifugal type circulating pump (located over an opening in the front of the engine block) is used to circulate the coolant through the engine block, cylinder head(s) and manifold(s), thus removing the heat given off by these parts as the coolant passes. The heated coolant then is routed to the heat exchanger where it is cooled. After the coolant passes through the heat exchanger, it is routed back to the circulating pump where it again is re-circulated.

Flow Diagram



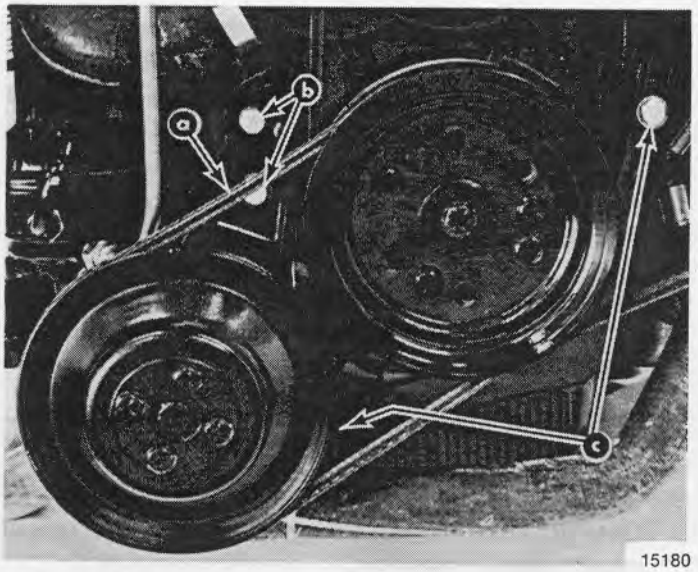
372-H

Seawater Pickup Pump

Removal

IMPORTANT: If boat is in the water when removing seawater inlet hose, either plug hose or raise above water level to prevent water from entering.

1. Remove hoses from pump.
2. Loosen but do not remove pulley bolts.
3. Loosen brace and mounting bracket bolts and remove belt.



15180

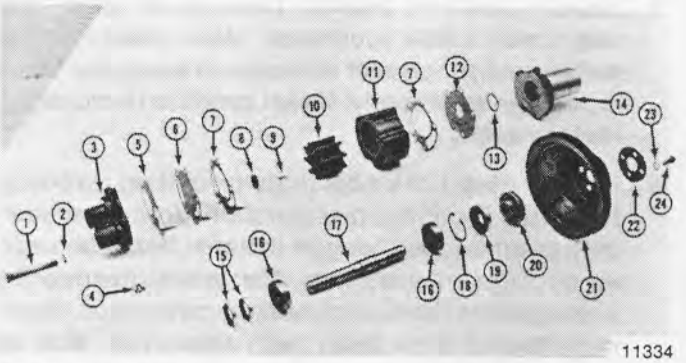
a - Pump Belt
b - Pump Mounting Screws
c - Adjusting Brace Attaching Screws (One Hidden)

4. Remove bolts and pulley.
5. Remove brace and pump assembly.

Disassembly

NOTE: The following instuctions are for complete disassembly and overhaul of pump. In many cases, however, complete disassembly of pump is not required and in those cases, it is necessary only to perform the operations which are required to repair or replace the faulty parts.

1. Remove 5 bolts and washers which secure pump cover to pump, then remove cover, cover to outer wear plate gasket, wear plate and wear plate to pump body gasket. Discard gaskets.
2. Slide impeller and pump body off shaft. Remove impeller from pump body and rubber plug from impeller.
3. Remove impeller drive key from pump shaft, then remove pump body to inner wear plate gasket, inner wear plate and "O" ring. Discard gasket and "O" ring.



11334

1 - Cover Bolts (5)
2 - Washers, Cover Bolt (5)
3 - Cover
4 - Pipe Plug
5 - Gasket (Cover to Outer Wear Plate)
6 - Outer Wear Plate
7 - Gasket (Wear Plate to Pump Body)
8 - Rubber Plug
9 - Impeller Drive Key
10 - Impeller
11 - Pump Body
12 - Inner Wear Plate
13 - "O" Ring
14 - Bearing Housing
15 - Oil Seal (Rear)
16 - Ball Bearings (2)
17 - Pump Shaft
18 - Snap Ring
19 - Oil Seal (Front)
20 - Pulley Hub
21 - Pulley
22 - Clamping Ring
23 - Lockwashers (4)
24 - Pulley Bolts (4)

4. Press pulley hub off shaft with Universal Puller Plate 91-37241 and an arbor press.
5. Puncture front oil seal with a screwdriver or similar tool and pry from bearing housing.
6. Remove snap ring from bearing housing bore and press shaft and bearings out pulley end of housing.
7. Remove bearings from shaft with Universal Puller Plate or equivalent and an arbor press. DO NOT press on outer race, or bearing may be damaged.
8. If seals require replacement, press 2 rear oil seals from housing with an appropriate tool. Discard seals.

Cleaning and Inspection

1. Clean metal parts in solvent and blow dry with compressed air. DO NOT allow solvent to remain on seals for any length of time, as seals may be damaged. DO NOT spin bearings at high speed when drying with compressed air, as bearings may be scored.
2. After cleaning, apply a coat of light engine oil to shaft and bearings to prevent rust.
3. Clean all traces of gasket material and sealing compound from sealing surfaces.
4. Inspect bearing housing for cracks. Also examine surfaces, where bearings contact housing, for evidence of bearing outer races turning in housing. If housing is cracked, or if bearings have been turning in housing, replace housing.

5. Inspect seals in bearing housing for wear, flat spots, tears and roughness. Also, check spring within seal for correct tension and to ensure that it is positioned properly. If seal condition is doubtful, replace seals.
6. Inspect pump shaft bearings for pitting, grooves, flat spots, scoring, discoloration (from overheating) or embedded foreign material. Replace bearing(s) if any of these exist. Also, check bearings by holding inner race and turning outer race. Bearings should turn freely with little-or-no side or end play.
7. Inspect pump shaft for grooves in surface where seals contact shaft. If grooves exist, both shaft and seals must be replaced. Inspect keyway in shaft for wear. Also inspect surface, where bearings contact shaft, for evidence of inner races turning on shaft. If keyway is worn or if bearings have been turning on shaft, replace shaft.
8. Inspect impeller drive key for excessive wear.
9. Inspect pump body for cracks, excessive wear and grooves.
10. Inspect inner and outer wear plate for excessive wear, grooves or warping.
11. Inspect pump impeller for wear on sides and tips of blades. Also inspect blades for cracks in area where blades flex. Check bending between impeller and impeller hub for cracks. Replace impeller if worn or cracked. Also replace impeller, if blades have taken a set (remain in curved position).
12. Inspect pump pulley for bends or warping and replace if present. Pulley MUST BE perfectly true (cannot wobble) when installed or damage to the pump and drive belt may result. Also, inspect pulley sheaves for pitting, nicks, burrs and corrosion. Repair damaged surfaces, if possible, using a fine file and a wire brush, or replace pulley if damaged beyond repair. Pulley sheaves must be smooth, or drive belt wear will be greatly accelerated.
13. Check drive belt for excessive wear (belt bottoms in pulley), fraying, glazing, cracks or other signs of deterioration. If belt condition is doubtful, replace belt.

Reassembly

1. Apply a thin coat of Loctite Type "A" to outside diameter of 2 new bearing housing rear seals, then install seals in housing with seal lips facing impeller end. (Press first seal in until it bottoms-out and second seal in until flush with housing.)

IMPORTANT: It is recommended that Shell Alvania No. 3 Grease be used when packing seals and bearing in the following steps. If Shell Alvania No. 3 Grease is not available, it is permissible to use U-Joint Lubricant [from U-Joint Grease Kit (91-74057A1)]. However, U-Joint Lubricant is not recommended for applications where continuous high-speed heavy-duty operation will be encountered.

2. Pack cavity between seals with Shell Alvania No. 3 Grease or equivalent.
3. Press ball bearings onto shaft until they seat. Be sure to press on inner race of bearings only.
4. Pack bearings and cavity between bearings with Shell Alvania No. 3 Grease, then slide bearings and shaft into bearing housing bore and install snap ring.
5. Apply a thin coat of Loctite Type "A" to outside diameter of new bearing housing front seal and press seal into housing with seal lip facing inward.

IMPORTANT: Be sure to support impeller end of pump shaft, when installing pulley hub in next step, to prevent placing a load on bearings.

6. Press pulley hub onto pump shaft until shaft protrudes 1/4" (6.4mm) from hub.
7. Position pump so that impeller end of pump is up. Coat "O" ring with U-Joint Lubricant and install into groove in housing.
8. Place inner wear plate on housing and align holes with holes in pump. Coat pump body to wear plate gasket with Perfect Seal and position on wear plate.
9. Install impeller into pump body by turning impeller in direction that it will be turning in operation, while simultaneously pushing inward. Impeller blades all MUST BE pointed in same direction.
10. Apply a small amount of grease to back side of impeller drive key and position key in keyway on shaft. Align groove in impeller hub with drive key, then slide impeller and pump body assembly onto shaft and position so that holes in pump body align with threaded holes in bearing housing.
11. Coat both sides of new cover to outer wear plate gasket and outer wear plate to pump body gasket with Perfect Seal. Install outer wear plate with new gasket on each side. Be sure to align holes properly.
12. Install pump cover and secure with 5 bolts and washers. Torque bolts to 10 ft. lbs. (13.5 N.m).

Installation

1. Slide mounting bracket onto pump. DO NOT tighten clamping bolt at this time.
2. Reattach pump and mounting bracket assembly to engine.
3. Attach pump and mounting bracket assembly to cylinder block with bolts, lockwashers and flat washer. (Install flat washer under lower bolt.)
4. Reconnect adjusting brace to pump mounting bracket with bolt, washer(s) and nut. DO NOT tighten bolt at this time.
5. Install pulley on pump and secure with 4 bolts, lockwashers and clamping ring (if so equipped). Tighten bolts securely.
6. Move seawater pickup pump fore or aft in mounting bracket, as required, to properly align pump pulley with crankshaft pulley. Also, rotate pump, as required, to align outlet hose connection on back of pump with outlet hose.
7. After pump has been positioned properly, torque mounting bracket clamping bolt to 20 ft. lbs. (27 N.m).
8. Reconnect inlet and outlet hoses to corresponding connections on aft end of pump and secure with hose clamps.
9. Install drive belt on pump and crankshaft pulleys and adjust tension, as follows:
   a. Pivot pump and mounting bracket assembly away from crankshaft pulley, as required, until a strand tension gauge reading of 65 to 95 lbs. (29-43kg) is obtained when taken at point midway between crankshaft pulley and pump pulley. (Use high value for a new belt.) If strand tension gauge is not available, adjust tension so that upper strand of belt can be depressed 1/4" (6.4mm) with thumb pressure at same point.
   b. After obtaining correct tension, tighten pump mounting bracket and brace attaching bolts securely.

Closed Cooling System Pressure Test

If fresh water section of Closed Cooling System is suspected of leaking or not holding sufficient pressure, and no visible signs of leakage can be found, perform the following test:

⚠WARNING

Fresh water section of Closed Cooling System is equipped with a 14 psi (97 kPa) pressure cap. Before removing pressure cap (in next step), first allow engine to cool down, as sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled off, turn pressure cap 1/4-turn to allow pressure to escape slowly, then turn cap all-the-way off.

1. Remove pressure cap from heat exchanger or reservoir.
2. Clean, inspect and pressure test pressure cap, as outlined under "Closed Cooling System Maintenance in this section, to eliminate the possibility that cap is not maintaining proper pressure in system and is causing coolant to boil over.
3. Clean inside of filler neck to remove any deposits or debris. Examine lower inside sealing surface for nicks or other damage. Surface MUST BE perfectly smooth to achieve a good seal between it and rubber seal on cap. Also, check locking cams on sides of filler neck to be sure that they are not bent or damaged. If locking cams are bent or damaged, pressure cap will not hold the proper pressure.
4. Adjust coolant level in fresh water section to 1" (25.4mm) below filler neck.
5. Attach an automotive-type cooling system pressure tester to filler neck and pressurize fresh water section to 17 psi (117 kPa).
6. Observe gauge reading for approximately 2 minutes; pressure should not drop during this time. If pressure drops proceed with the following steps until leakage is found.
7. While maintaining a pressure of 17 psi (117 kPa) on fresh water section, visually inspect external portion of cooling system (hoses, gaskets, drain plugs, petcock(s), core plugs, circulating pump seals, etc.) for leakage. Also listen closely for bubbling or hissing, as they usually are a sure indication of a leak.
8. Remove seawater outlet hose from heat exchanger. (Refer to "Cooling System Flow Diagrams", if necessary, for hose location.) Repressurize system to 17 psi (117 kPa) and observe outlet connection on heat exchanger. If water flows from connection, or if air bubbles are present in water, a leak exists between fresh water section and seawater section of heat exchanger. Also listen for bubbling or hissing as this is a certain indication of leakage. Reconnect hose if no evidence of leakage is found.

9. If no leakage could be found in above steps, engine is leaking internally, and it probably is due to one or more of the following: 1) Loose cylinder head bolts or damaged gasket, 2) loose intake manifold bolts or damaged gasket, 3) loose exhaust elbow or distribution block retaining nuts or damaged gasket, 4) cracked or porous cylinder head or block, 5) cracked or porous exhaust manifold or intake manifold.

Proceed as follows until location of internal leak is found:

a. Start engine. Repressurize system to 17 psi (117 kPa) and observe pressure gauge on tester. If needle in gauge vibrates, compression or combustion is leaking into fresh water section from a leak in the combustion chamber. Exact cylinder(s), where leakage is taking place, sometimes can be found by removing spark plug wires (one at a time) while observing pressure gauge. Vibration will decrease or stop when spark plug wire is removed from leaking cylinder. Stop engine.

b. Remove spark plugs (one at a time) from cylinders and examine for presence of coolant. A spark plug, that is perfectly clean or milky appearing, is a sure indication of a leak.

c. Drain oil from engine and examine for presence of coolant. Oil usually will be milky, if coolant is present. If coolant is present, remove engine from boat and drop the oil pan. With engine in the upright position, repressurize fresh water section to 17 psi (117 kPa) and examine internal surfaces of engine to locate leak.

d. If no leakage can be found in above steps, entire engine must be disassembled and inspected for leakage.

Closed Cooling System Maintenance

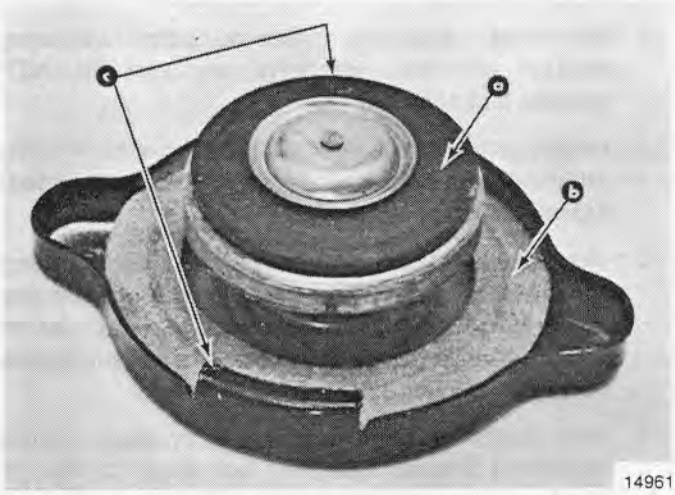
Pressure Cap

Pressure cap is designed to maintain a pressure of approximately 14 psi (97 kPa) in fresh water section once engine has attained operating temperature. Cap should be cleaned, inspected and pressure-tested at regular tune-up intervals or whenever cap is suspected of maintaining improper pressure, as follows:

⚠WARNING

Engine MUST BE cooled down before removing pressure cap (in next step), as sudden loss of pressure could cause coolant to boil and discharge violently. After engine has cooled down, turn pressure cap 1/4-turn to allow pressure to escape slowly, then turn cap all-the-way off.

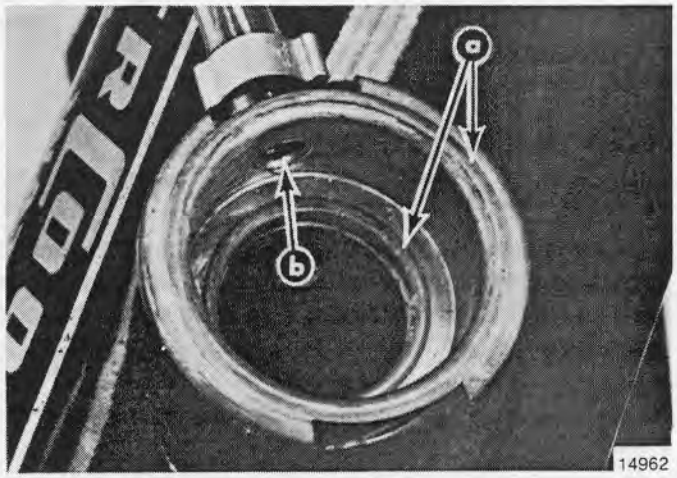
1. Carefully remove pressure cap from reservoir or heat exchanger.
2. Wash cap with clean water to remove any deposits or debris from sealing surfaces.
3. Inspect gasket (if used) and rubber seal on cap for tears, cuts, cracks or other signs of deterioration. Replace gasket, if damaged, or entire cap, if rubber seal is damaged.
4. Check that locking tabs on cap are not bent or damaged.



14961

a - Rubber Seal
b - Coolant Recovery Gasket
c - Locking Tabs (1 Hidden)

5. Using a cooling system pressure tester, test cap to be sure that it releases at proper pressure and does not leak. (Refer to instructions which accompany tester for correct test procedure.) Cap MUST relieve pressure between 11 and 17 psi (76-117 kPa) and must hold rated pressure for 30 seconds without going below 11 psi (76 kPa). Replace cap if it fails to fall within these limits.
6. Clean sealing surface on heat exchanger filler neck with a cloth. Inspect surfaces for any damage or deposits that may prevent cap from sealing properly. Clean coolant recovery passage in heat exchanger filler neck with a wire and blow out with compressed air.



14962

a - Pressure Cap Sealing Surface
b - Coolant Recovery Passage

7. Reinstall pressure cap, being sure to tighten until it contacts stops on filler neck.

Testing Coolant For Alkalinity

Coolant in fresh water section should be replaced once every 2 years and should be tested for alkalinity every other year, as follows:

⚠WARNING

Fresh water section of Closed Cooling System is equipped with a 14 psi (97 kPa) pressure cap (fill cap). Before removing pressure cap (in next step), first allow engine to cool down, as sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled, turn pressure cap 1/4-turn to allow pressure to escape slowly, then turn cap all-the-way off.

1. Obtain pink litmus paper from local supplier (laboratory, drug store, pet shop, etc.).
2. Remove pressure cap (fill cap) from heat exchanger or reservoir and insert one end of litmus paper into coolant.
3. If pink litmus paper turns blue, coolant is alkaline and need not be replaced.
4. If pink litmus paper remains pink, coolant is not alkaline and MUST BE replaced. Drain and refill fresh water section in accordance with "Drain Instructions" and "Filling Instructions - Closed Cooling System".

Cleaning Fresh Water Section

Fresh water section of Closed Cooling System should be cleaned at least once every 2 years or whenever decreased cooling efficiency is experienced.

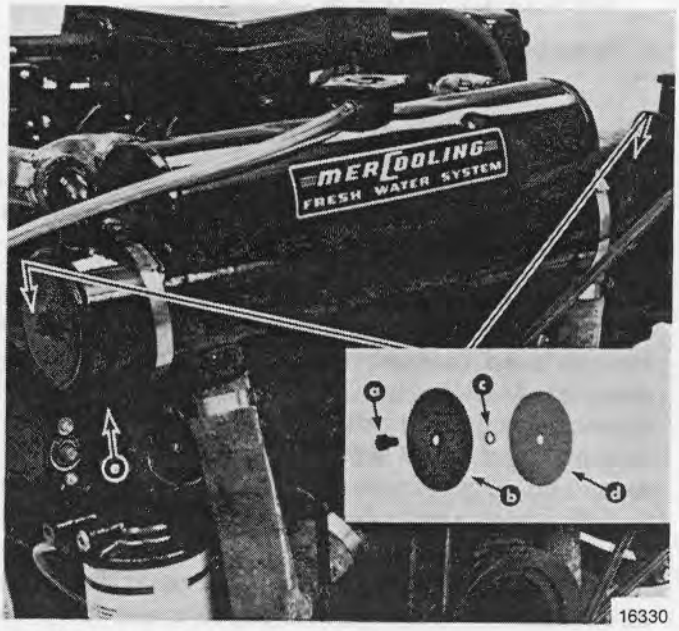
A good grade automotive cooling system cleaning solution may be used to remove rust, scale or other foreign material. Manufacturer's instructions, which accompany particular cleaner, always should be followed.

If fresh water section is extremely dirty, a pressure flushing device may be used to flush out remaining deposits. Flushing should be done in direction opposite normal coolant flow to allow water to get behind deposits and force them out. Refer to "Cooling System Flow Diagrams", preceding, and instructions which accompany flushing device for proper hookup and flushing procedure.

Cleaning Seawater Section of Heat Exchanger

During operation, contaminants in the seawater (such as salt, lime, etc.) may collect on tubes within heat exchanger and reduce their cooling efficiency. This will cause coolant temperature to gradually rise until an overheating condition exists. To prevent this from happening, seawater section of heat exchanger should be cleaned at least once each year or whenever a gradual rise in temperature is observed on water temperature gauge. Clean seawater section of heat exchanger as follows:

1. Remove seawater drain plug from bottom of heat exchanger and allow water to drain. After water has drained completely, coat threads of drain plug with Quicksilver Perfect Seal and reinstall.
2. Remove end cover attaching screw, end cover, fiber washer and gasket from each end of heat exchanger. Discard fiber washers and gaskets.
3. Clean old gasket material from end covers and heat exchanger. Remove any debri from cavities on ends of heat exhanger.

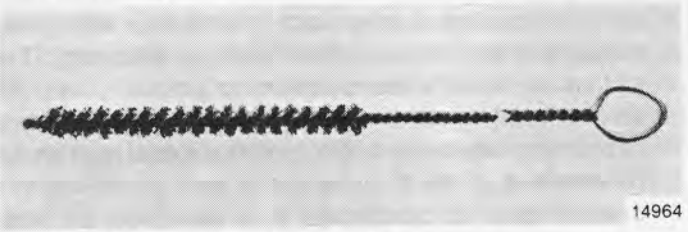


a - End Cover Attaching Screw (One Each End)
b - End Cover (One Each End)
c - Fiber Washer (One Each End)
d - Gasket (One Each End)
e - Seawater Drain Plug

⚠CAUTION

DO NOT use an object with sharp corners or without a brush to clean heat exchanger tubes (in next step), as damage to tubes may result.

4. Clean tubes in heat exchanger by running a suitable wire brush (similar to one shown) thru each tube.



Heat Exchanger Cleaning Brush
Part No. 01299 (From Schaefer Brush Mfg. Co., Inc.)

NOTE: Heat exchanger cleaning brush Part No. 01299 (shown) can be obtained from the Schaefer Brush Manufacturing Company, Inc., 117 West Walker Street, Milwaukee, WI 53204.

5. Rinse out heat exchanger tubes with a water hose to remove loosened particles.
6. Apply Quicksilver Perfect Seal to both sides of NEW end cover gaskets. Reinstall end covers, using new gaskets and fiber washers. Tighten end cover attaching screws 1 - 1-1/2 turns past hand tight [36 to 72 lbs. in. (4.1 to 8.1 N.m)].
7. Start engine and check for leaks.

Cleaning Closed Cooling Section

Closed cooling section of cooling system should be cleaned whenever decreased cooling efficiency (due to internal deposits) is experienced.

A good grade automotive cooling system cleaning solution, that is compatible with copper and cast iron may be used to remove rust, scale or other foreign material. Manufacturer's instructions of particular cleaner being used, should be carefully followed to ensure a safe and effective cleaning operation. If closed cooling section is extremely dirty, a pressure flushing device may be used to flush out remaining deposits. Flushing should be done in direction opposite normal coolant flow (with thermostat removed) to allow water to reach behind deposits and force them out (refer to Closed Cooling System Flow Diagram"). Follow instructions which accompany flushing device for proper hookup and flushing procedure.

Filling Closed Cooling System

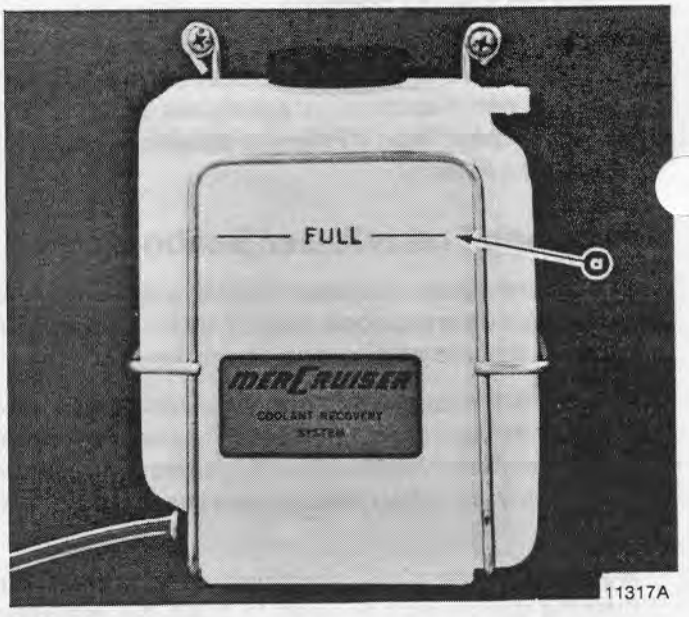
It is recommended that fresh water section be filled with a solution of ethylene glycol and pure soft water mixed to proportions recommended by manufacturer to protect engine to lowest temperature to which engine will be exposed.

If ethylene glycol (anti-freeze) is not available, and the possibility of freezing does not exist, it is permissible to use a solution of rust inhibitor and pure soft water mixed to manufacturer's recommendations. Fill fresh water section as follows:

1. Remove pressure cap (fill cap) from reservoir or heat exchanger.
2. Fill fresh water section with coolant solution until coolant level reaches top of filler neck.

⚠CAUTION
DO NOT operate engine without cooling water flowing thru seawater pickup pump (in next step), as pump (and possibly engine) will be damaged.

3. Start engine and run at fast idle (1000-1500 RPM). Add coolant solution to heat exchanger or reservoir, as required, to maintain coolant level at top of filler neck. Reinstall pressure cap after engine reaches normal operating temperature and coolant level remains constant.
4. On engines that are equipped with coolant recovery reservoir, remove cap from reservoir and fill to "Full" mark with coolant solution.



5. With engine still running, check entire cooling system for leaks. Also observe engine temperature gauge to be sure that engine temperature is normal.

⚠WARNING
Allow engine to cool down before opening pressure cap (in next step). Sudden loss of pressure (while engine is warm) could cause coolant to boil and discharge violently. After engine has cooled down turn pressure cap 1/4-turn to allow pressure to escape slowly, then turn cap all-the-way off.

6. Recheck coolant level in heat exchanger or reservoir after first open-throttle boat test and add coolant, if necessary.
7. On engines so equipped, maintain coolant level in coolant recovery reservoir between "Add" and "Full" marks with engine at normal operating temperature.

Closed Cooling

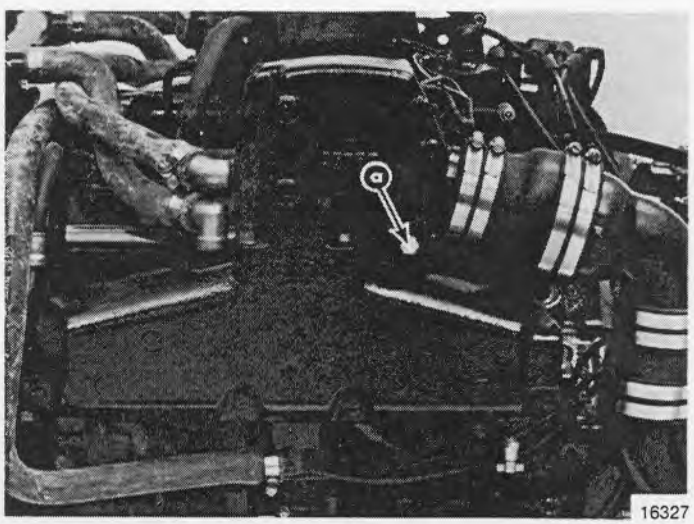
Draining Seawater Section

⚠CAUTION

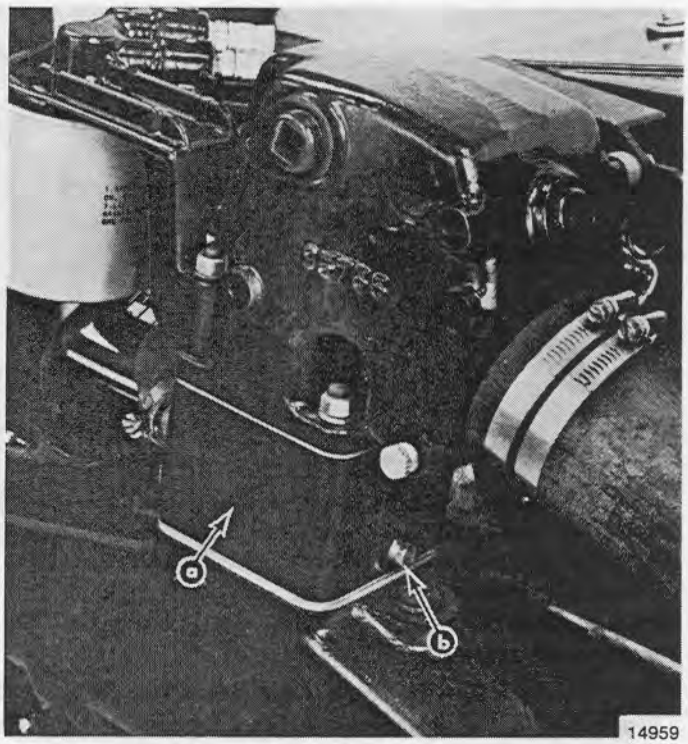
During freezing temperature months, fresh water section of Closed Cooling System should be kept filled with a solution of permanent anti-freeze and pure soft water (see "Filling Instructions"), but seawater section must be completely drained. If seawater section is not completely drained, water may freeze and cause severe damage to engine.

IMPORTANT: When draining cooling system, boat must be positioned so that engine is level, or cooling system will not drain completely. It also is advisable to insert a piece of wire into drain holes (remove petcocks) to ensure that sand, silt, rust or other foreign material is not obstructing the drain holes and preventing cooling system from draining completely.

1. If possible, place a container under drains to prevent water from draining into boat.
2. Remove drain plug from port and starboard exhaust elbows.

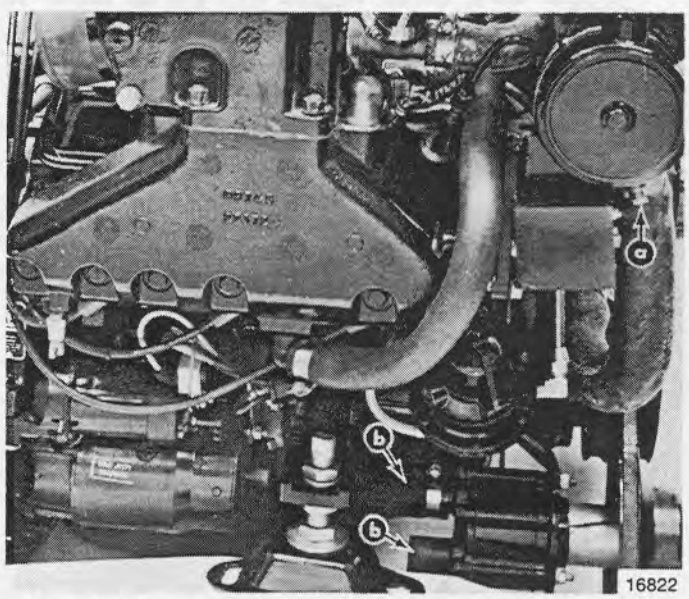


3. If engine is equipped with exhaust elbows risers (located under exhaust elbows), remove drain plug from front end of each riser.



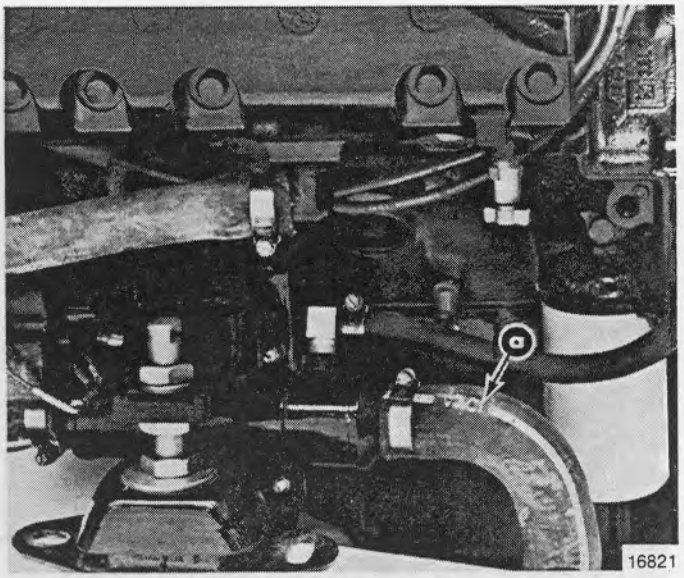
a - Exhaust Elbow Riser
b - Drain Plug

4. Remove drain plug from bottom of heat exchanger, and disconnect both hoses from aft-end of seawater pickup pump. Lower hoses to allow water to drain from lowest part.



a - Heat Exchanger Drain Plug
b - Pickup Pump Hoses

5. Disconnect hose from aft end of power steering fluid cooler and bend to allow water to drain from lowest part.

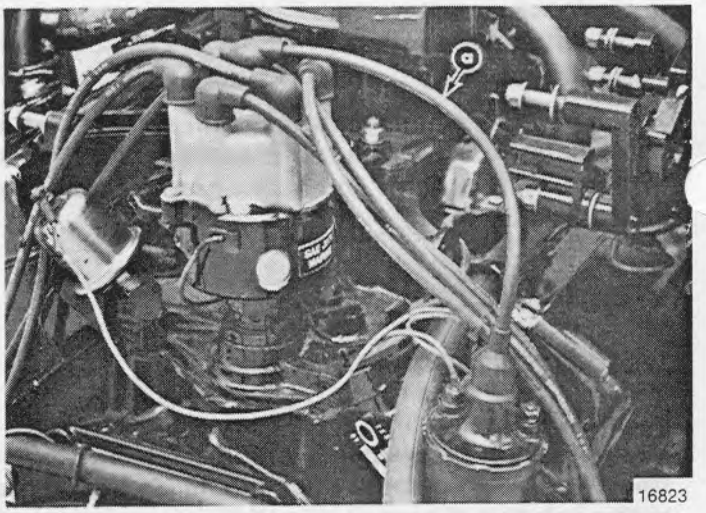


a - Power Steering Fluid Cooler-to-Heat Exchanger Hose

⚠WARNING

Be sure that engine compartment is well ventilated and that there are no gasoline vapors present (during the next step), to prevent the possibility of a fire. Also, be sure to ground ignition coil hi-tension wire to block. Failure to ground wire may cause damage to ignition coil, in addition to being a safety hazard.

6. Remove ignition coil hi-tension wire from distributor cap terminal and ground it to block with a jumper wire. Crank engine with starter motor to purge any water trapped in seawater pickup pump. Reinstall coil hi-tension wire, being sure to push it all-the-way onto distributor cap terminal.



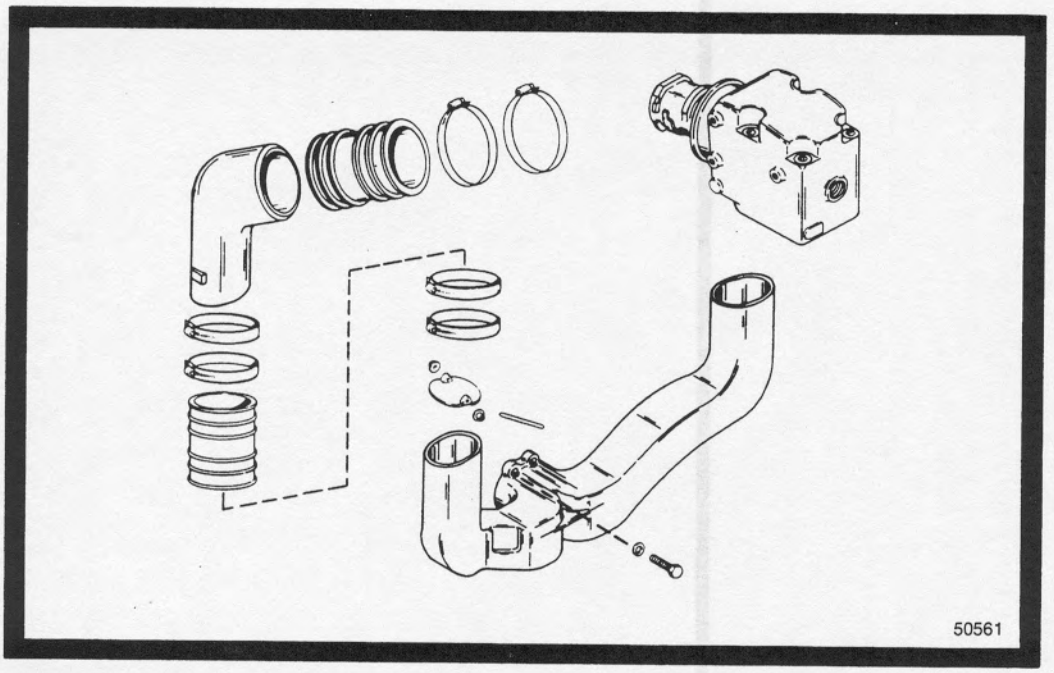
a - Ignition Coil Hi-Tension Wire

⚠CAUTION

If boat is in the water, water inlet valve (if so equipped) must be left closed until engine is to be restarted, to prevent water from flowing back into cooling system. If boat is not fitted with a valve, water inlet hose must be left disconnected and plugged. As a precautionary measure, attach a tag to the ignition switch or steering wheel with the warning that the valve must be opened or the hose reconnected prior to starting the engine.

7. After cooling system has drained completely, coat threads of drain plugs with Quicksilver Perfect Seal and reinstall. Reconnect hoses. Be sure to tighten hose clamps and drain plugs securely.

EXHAUST SYSTEM



6

C

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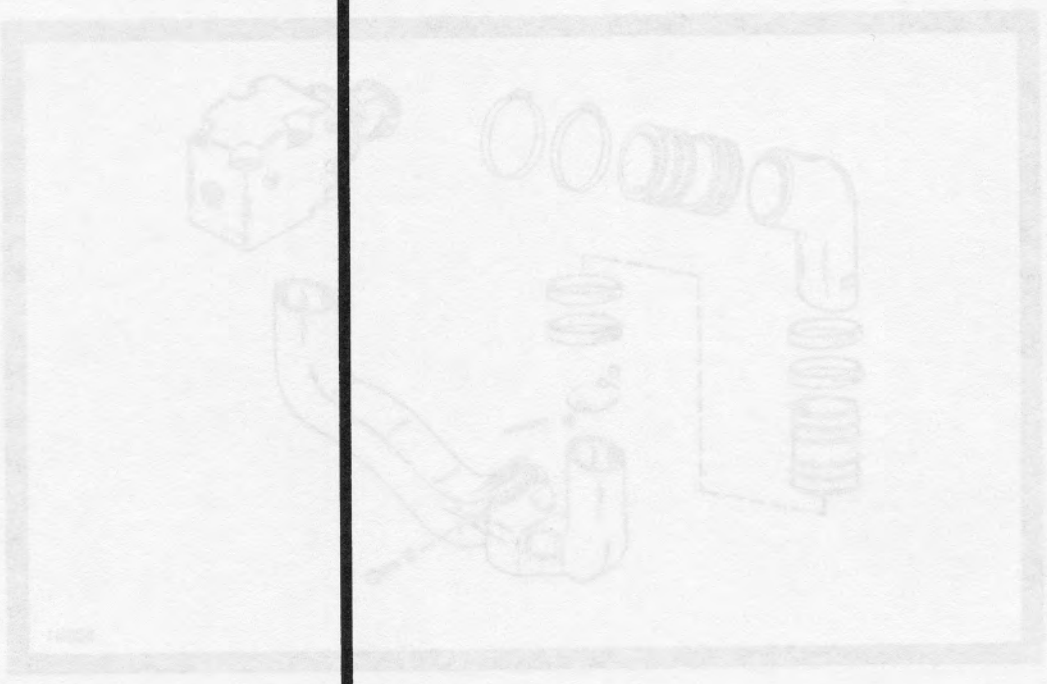


Torque Specifications

Fastener Location	Lb. Ft. (N·m)
Block Off Plate	23 (30)
Exhaust Pipe to Gimbal Housing	23 (30)
Exhaust Pipe to Tee Pipe	23 (30)
Hose Clamps	Securely
Tee Pipe to Gimbal Housing	23 (30)
Upper Exhaust Pipe to Lower Exhaust Pipe	23 (30)
Water Shutter Screw Nut (Earlier Models Only)	Securely

Sealants

Sealants	
92-86166	Quicksilver Bellows Adhesive
92-34227	Quicksilver Perfect Seal

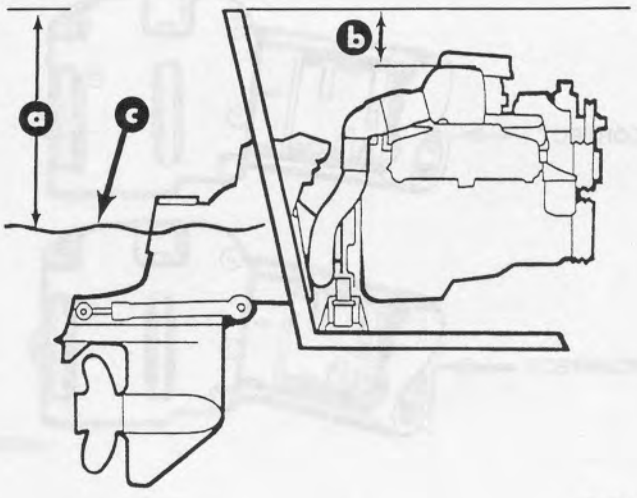
Exhaust System Requirements

Engines with Thru Drive/Thru Transom Exhaust

⚠CAUTION

It is the responsibility of the boat manufacturer or installing dealer to properly locate the engine and install the exhaust system. Improper installation may allow water to enter the exhaust manifolds and combustion chambers and severely damage the engine. Damage caused by water in the engine will not be covered by MerCruiser Warranty, unless this damage is the result of defective parts(s).

Determine if exhaust elbow risers are required by taking measurements "A" and "B" with boat at rest in the water and maximum load aboard. Subtract "B" from "A". If "A" minus "B" is less than specified in chart, select appropriate size exhaust elbow riser kit and exhaust extension kit that will correctly position exhaust elbow.



22053

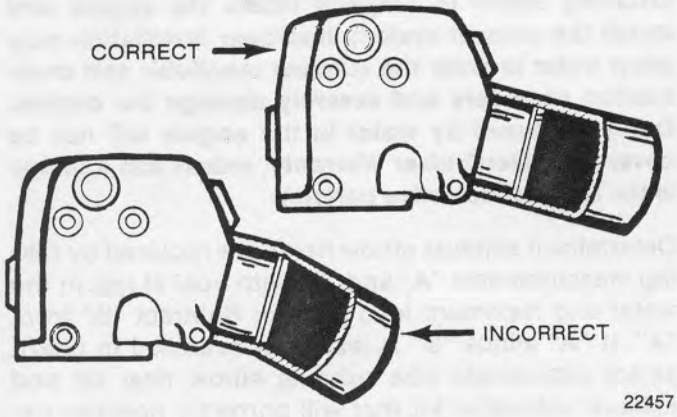
a - From Waterline to Top of Transom
b - From Highest Point on Exhaust Elbow to Top of Transom
c - Waterline

Model	"A" Minus "B" Must Be ➧ or More
All MCM V6 Engines	13" (330)
	13" (330)
	13" (330)

Engines With Thru Transom Exhaust

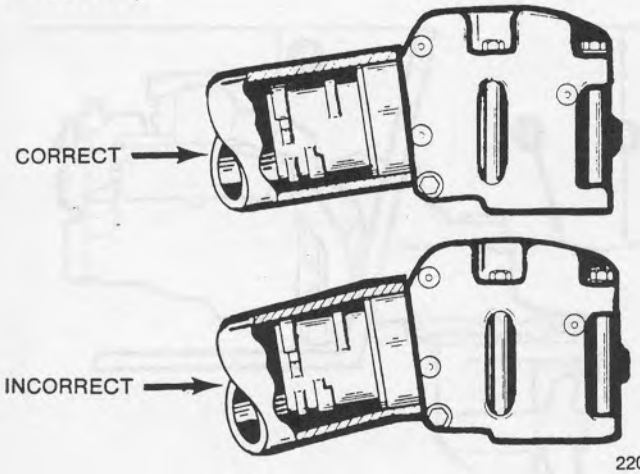
IMPORTANT: Exhaust hoses must not restrict discharge water flow at exhaust elbow. Transom outlet should have internal water shutters and outlet covers ("Flappers") on outside.

15° ELBOWS (Earlier MIE Models)



22457

7° ELBOWS

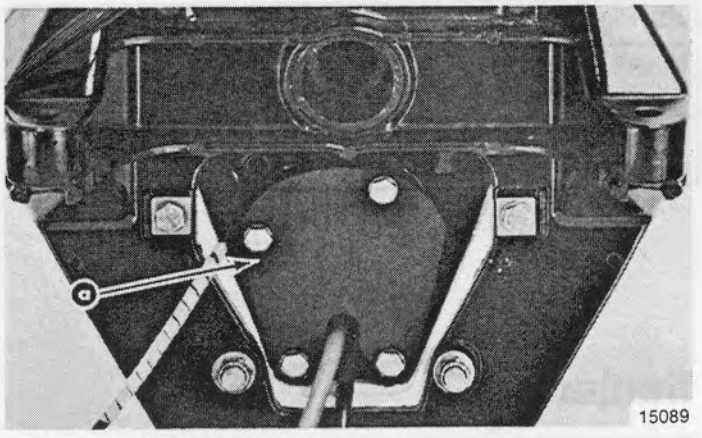


22032

There are no kits to convert these engines from thru drive to thru transom exhaust. By using block off plates, inboard exhaust elbows, exhaust hoses and transom outlet fittings, many engines have been converted to thru transom exhaust. In addition to the preceding information, the following should be adhered to:

a. "Exhaust Elbow Measurement" must be checked.

b. Block-off plates (for drive exhaust system) must be able to prevent water from entering the boat.



15089

a - Block Off Plate P/N 97350

c. Exhaust bellows (between gimbal housing and bell housing) should be removed to allow propeller to draw air.

Riser Component Replacement and Installation, if Equipped

1. Install Kit as shown in applicable drawing which applies to your installation, elbow type, and engine cooling system.

IMPORTANT: Exhaust elbows and manifold must be drained to prevent water from entering combustion chambers.

- Remove and discard old gaskets, being sure to remove all gasket material from surfaces.
- Replace original studs or screws. Tighten new studs securely.
- Coat both sides of gasket, only, with Quicksilver Perfect Seal.

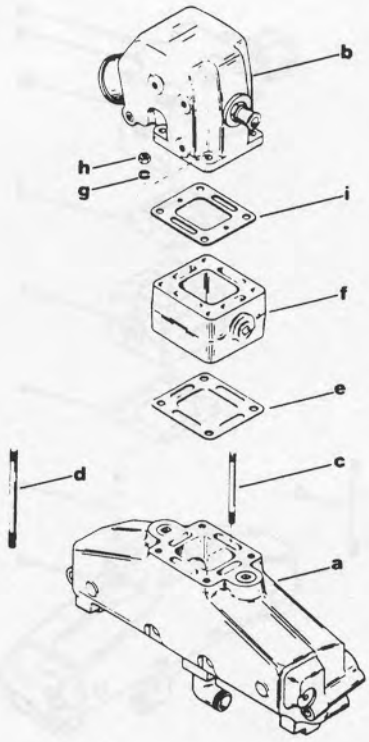
IMPORTANT: Restrictor gaskets or separator gaskets must be installed in order shown.

- Install each riser with drain plug facing downward and toward rear of boat.
- Torque exhaust elbow attaching nuts evenly, in a diagonal manner, to 23 lb. ft. (30 N·m).
- On some engines it may be necessary to modify or replace exhaust elbow hose. If necessary, fabricate replacement using bulk hose.

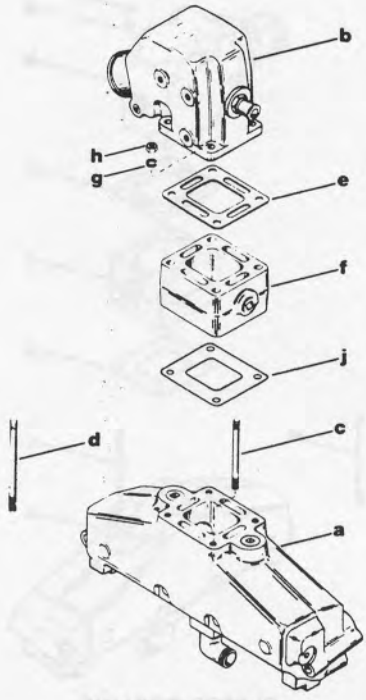
IMPORTANT: If ignition amplifier is removed from exhaust elbow, be sure to reconnect amplifier and wiring harness wires to one of attaching screws. Also, be sure spacers are installed between amplifier and exhaust elbow.

2. If kit is installed on stern drive (MCM) model with 3" diameter exhaust system install exhaust extension kit, as shown. Tighten all hose clamps securely.

15° ELBOWS



STANDARD COOLING

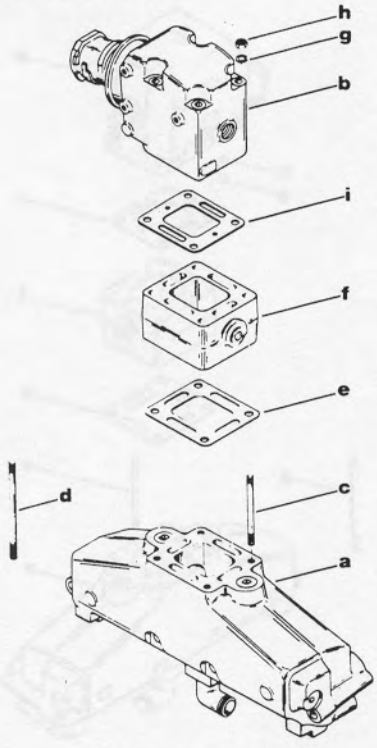


CLOSED COOLING

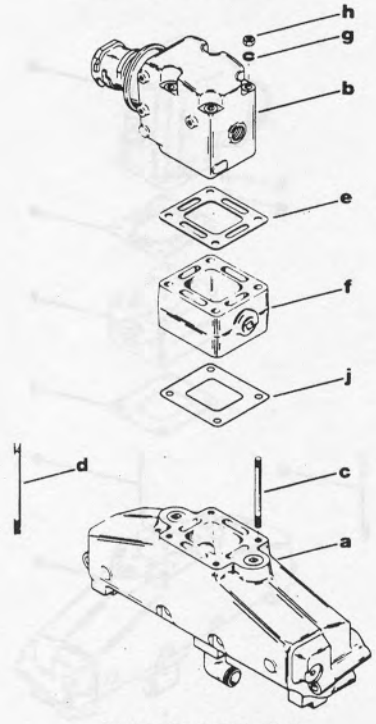
ORIGINAL
- a - Exhaust Manifold
- b - Exhaust Elbow
- c - Stud (4), 5" (127mm); Each Manifold
- d - Stud, remote oil filter bracket (2), 6-1/2" (165mm)

KIT
- e - Gasket
- f - Riser
- g - Lockwasher (4)
- h - Nut (4)
- i - Restrictor Gasket
- j - Separator Gasket

7° ELBOWS WITH STUDS



STANDARD COOLING



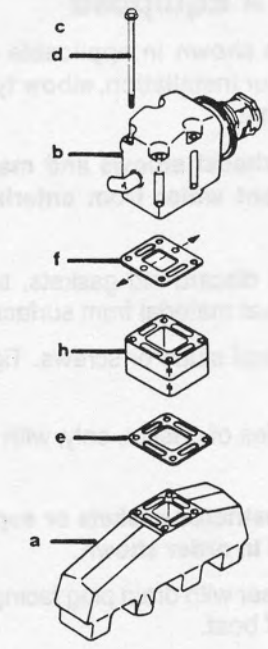
CLOSED COOLING

ORIGINAL
- a - Exhaust Manifold
- b - Exhaust Elbow

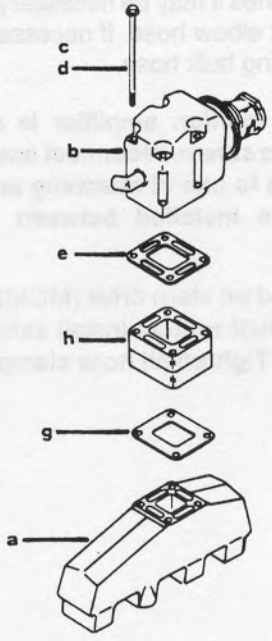
KIT
- c - Stud (4), 9-9/16" (243mm); Each Manifold
- d - Stud, remote oil filter bracket (2), 10-9/16" (268mm)
- e - Gasket
- f - Riser
- g - Lockwasher (4)
- h - Nut (4)
- i - Restrictor Gasket
- j - Separator Gasket

NOTE: Drain plugs in risers face toward stern.

7° ELBOWS WITH SCREWS



STANDARD COOLING



26516

CLOSED COOLING

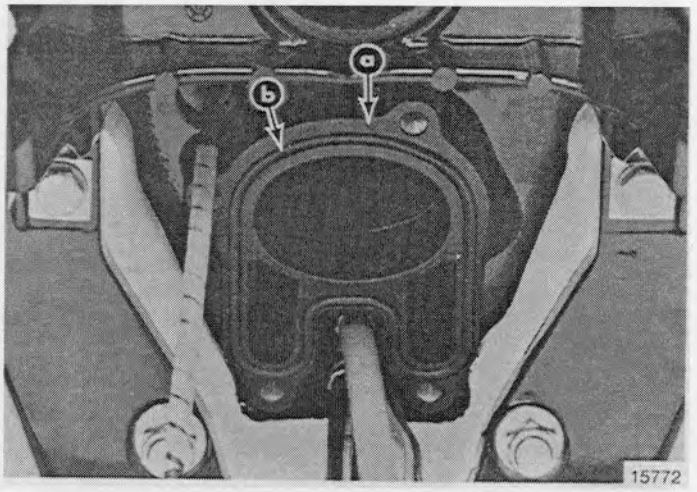
ORIGINAL
- a - Exhaust Manifold
- b - Exhaust Elbow

KIT
- c - Bolt (4), 8-7/8 in. (225mm)
- d - Bolt, remote oil filter bracket (2), 9-7/8 in. (251mm)
- e - Gasket - Lightly Coat Both Sides with Perfect Seal
- f - Restrictor Gasket
- g - Separator Gasket
- h - 3 in. (76mm) Exhaust Riser

NOTE: Drain plugs in risers face toward stern.

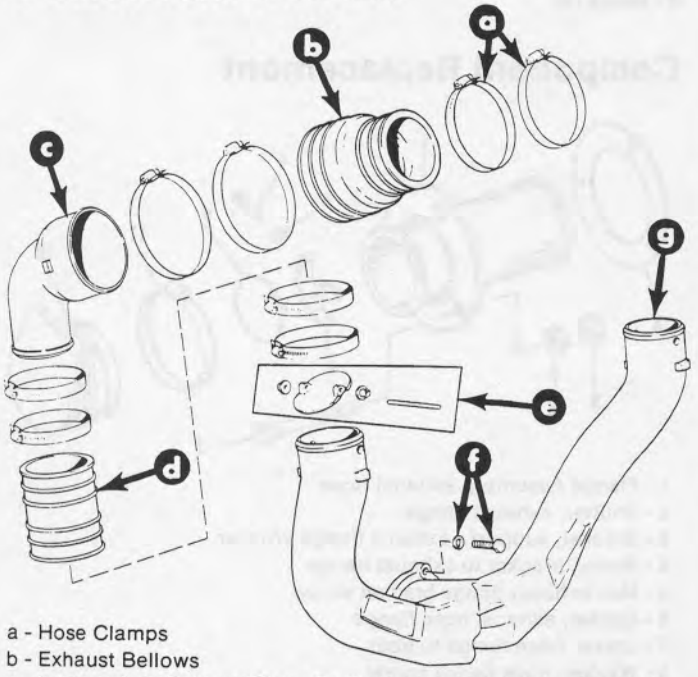
Exhaust Component and Shutter Replacement

1. To replace any component in system as shown, the following must be adhered to:
   a. All mating joint surfaces must be clean.
   b. "O" ring must remain in groove to properly seal joint to prevent leakage.
   c. Torque all screws and lockwashers to specifications.
   d. Tighten all clamps securely.



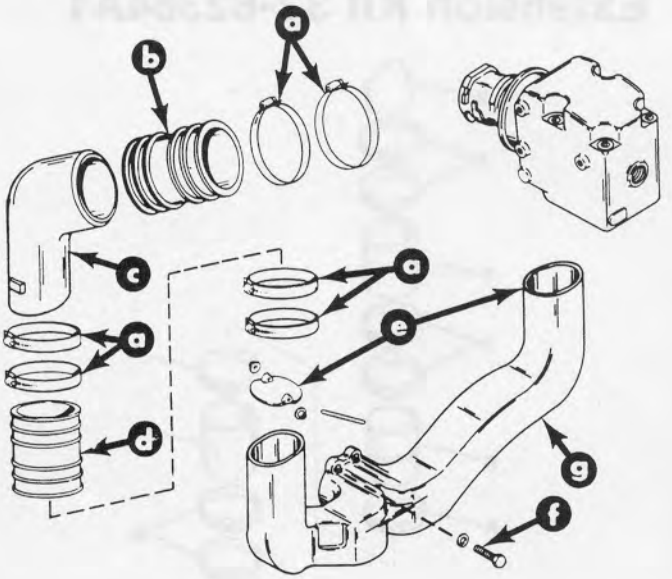
a - Mating Surface
b - "O" Ring

15° 3 INCH EXHAUST SYSTEM



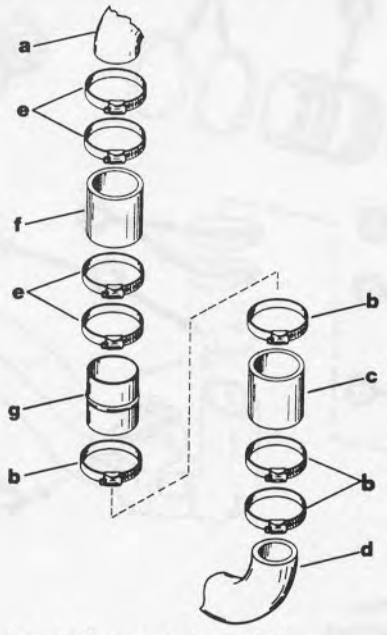
a - Hose Clamps
b - Exhaust Bellows
c - Intermediate Exhaust Pipe - Early Models Use Casting 94443 On Both Sides, Later Models Use Casting 94443 On Starboard Side and Casting 94444 On Port Side
d - Exhaust Tube
e - Water Shutters
f - Screws and Lockwashers
g - Exhaust Pipe - Refer to Part List for Correct One

7° 4 INCH EXHAUST SYSTEM



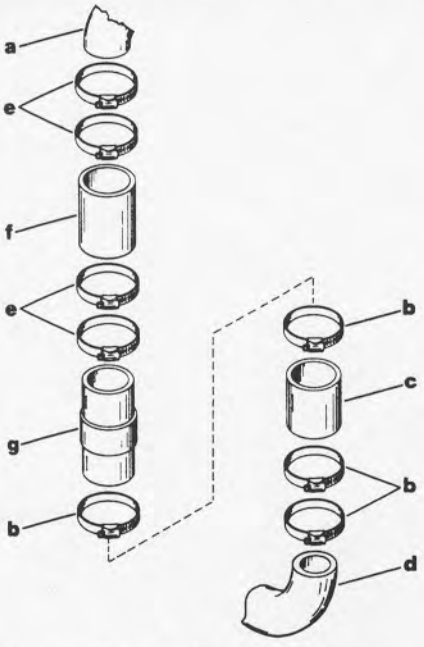
a - Hose Clamps
b - Exhaust Bellows
c - Intermediate Exhaust Pipe
d - Exhaust Tube
e - Water Shutters
f - Screws and Lockwashers (3 - Earlier Models; 4 - Later Models)
g - Exhaust Pipe

MCM 3" Exhaust Hose Extension Kit 32-62364A1



a - Original Exhaust Elbow or Exhaust Tube
b - Original Clamps
c - Original Exhaust Bellows
d - Original Exhaust Pipe
e - Clamps - From Kit
f - Exhaust Hose [3-1/4" (83mm)] - From Kit
g - Exhaust Tube [3" (76mm)] - From Kit

MCM 6" Exhaust Hose Extension Kit 32-59077A1

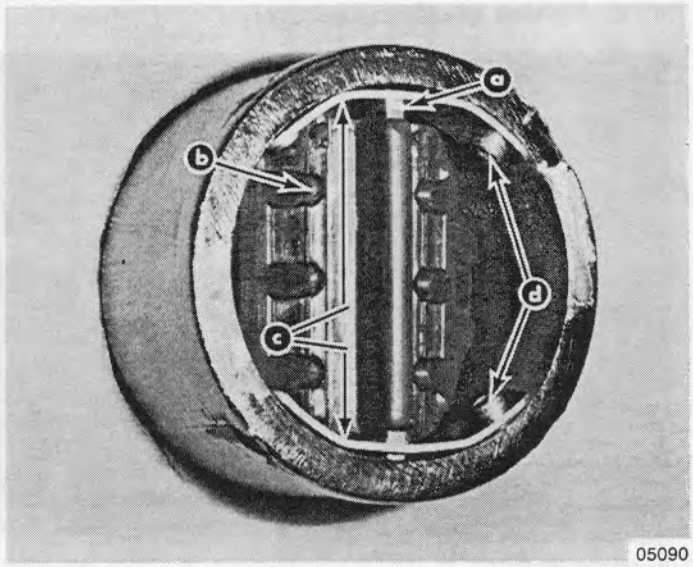


a - Original Exhaust Elbow or Exhaust Tube
b - Original Clamps
c - Original Exhaust Bellows
d - Original Exhaust Pipe
e - Clamps - From Kit
f - Exhaust Hose [4" (102mm)] - From Kit
g - Exhaust Tube [5-13/16" (148mm)] - From Kit

Thru Transom Exhaust Flange

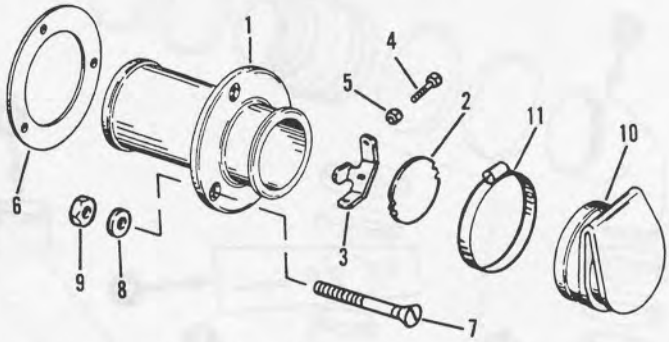
Shutter Replacement

1. Remove exhaust hose clamps, then hose.
2. Chisel rivets away from both support members.
3. Install new shutter as shown. Tighten screws and nut securely.
4. Reinstall exhaust hose. Tighten clamps securely.



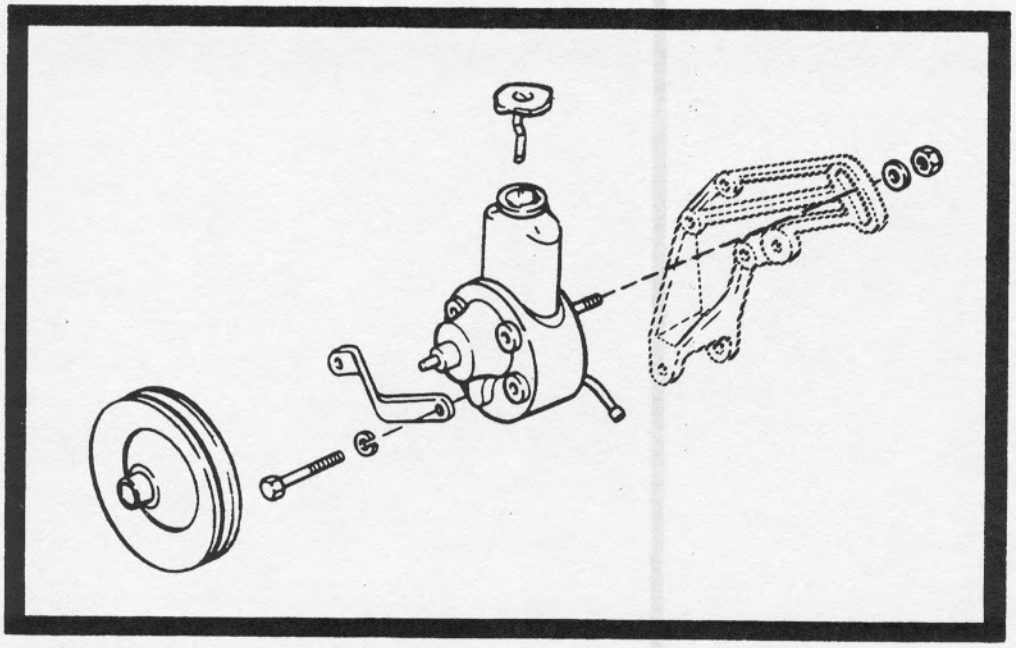
a - Shutter Hinge
b - Water Shutter - Opens Toward Outside of Boat
c - Support Member
d - Rivets (4)

Component Replacement



1 - Flange Assembly, exhaust hose
2 - Shutter, exhaust flange
3 - Bracket, support - exhaust flange shutter
4 - Screw, bracket to exhaust flange
5 - Nut, exhaust flange bracket screw
6 - Gasket, exhaust hose flange
7 - Screw, hose flange to boat
8 - Washer, hose flange screw
9 - Nut, hose flange screw
10 - Cover Kit, exhaust flange
11 - Clamp, cover to flange

POWER STEERING



A 7

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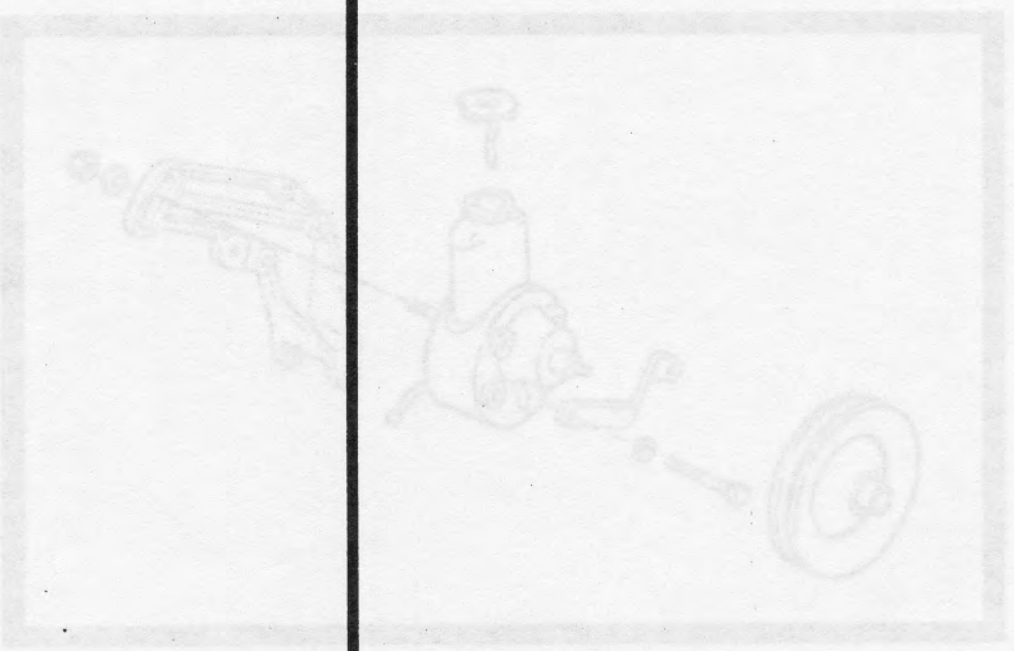


Torque Specifications

Fastener Location	Lb. Ft. (N.m)	Lb. In. (N.m)
Crankshaft Pulley to Harmonic Balancer	35 (42)	
Harmonic Balancer to Crankshaft	60 (81)	
Pump Mounting Bracket to Engine	30 (41)	
Recirculation Pump Pulley		240 (27)
Power Steering Pump to Bracket	Tighten Securely	

Tools/Sealants/Fluids

MERCURY MARINE SPECIAL TOOLS	
91-93656A1	Pulley Installer

KENT-MOORE SPECIAL TOOLS	
Can be ordered from: Kent Moore Tools, Inc. 29784 Little Mack Roseville, MI. 48066 Phone: (313) 774-9500	
J-25034	Pulley Removal Tool

SEALANTS/FLUIDS	
92-34227-1	Quicksilver Perfect Seal
92-90100A12	Quicksilver Power Trim and Steering Fluid
Obtain Locally	Dexron or Dexron II (ATF) Automatic Transmission Fluid

Precautions

⚠WARNING
Always disconnect battery cables from battery BEFORE working on engine to prevent fire or explosion.

⚠CAUTION
DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

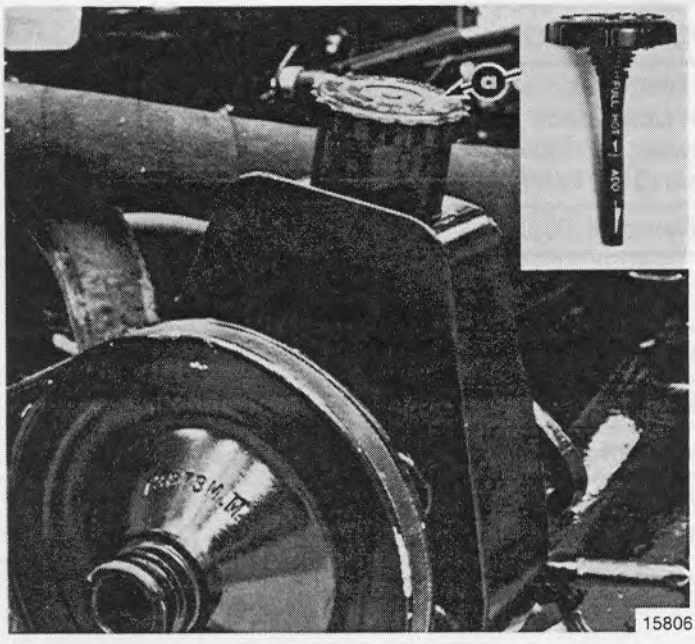
⚠CAUTION
DO NOT pry on Power Steering pump when adjusting belt tension. Serious damage may result.

Checking Fluid Level

IMPORTANT: Use only Quicksilver Power Trim and Steering Fluid or automatic transmission fluid (ATF), Dexron or Dexron II in Power steering System.

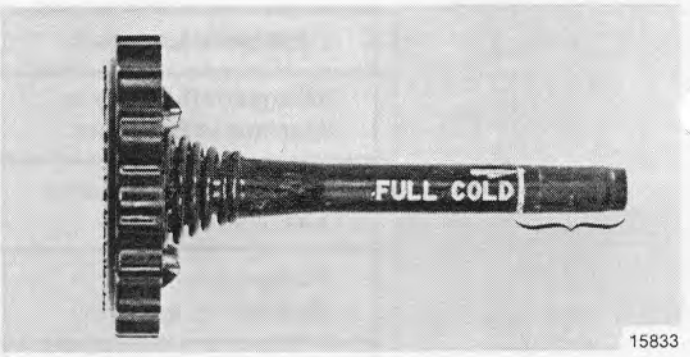
With Engine Cold

1. Stop engine and position drive unit so that it is straight back.
2. Remove fill cap/dipstick from Power Steering pump and note fluid level.



a - Fill Cap

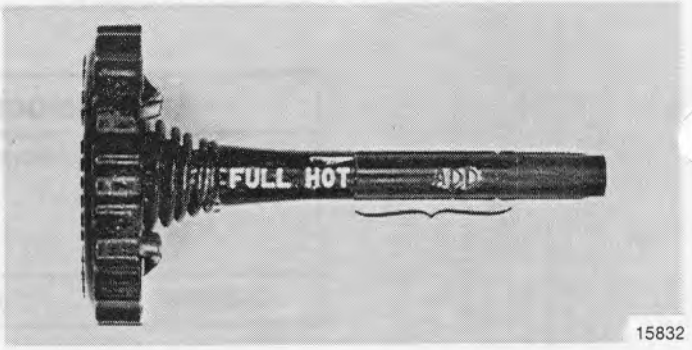
3. Level should be between "FULL COLD" mark and bottom of dipstick.



4. If fluid level is low but, still visible in pump reservoir, add fluid, thru fill cap opening to bring level up to "FULL COLD" mark on dipstick. Do not overfill.

With Engine Warm from Operation

1. Stop engine and position drive unit so that it is straight back.
2. Remove fill cap/dipstick from Power Steering pump and note fluid level.
3. Level should be between the "FULL HOT" mark and "ADD" mark on dipstick.



4. If level is low (below "ADD" mark), but still visible in pump reservoir, add fluid, thru fill cap opening to bring level up to "FULL HOT" mark on dipstick. Do not overfill.

Filling and Bleeding

IMPORTANT: Power Steering system must be filled exactly as explained, following, to be sure that all air is bled from the system. All air must be removed, or fluid in pump may foam during operation and be discharged from pump reservoir. Foamy fluid also may cause Power Steering system to become spongy, which may result in poor boat control.

1. Position drive unit so that it is straight back. Remove shipping cap from Power Steering pump and check fluid level with dipstick attached to fill cap (provided). Add fluid, as required, to bring level up to "Full-Cold" mark on dipstick.

IMPORTANT: Use only Quicksilver Power Trim and Steering Fluid or automatic transmission fluid (ATF), Dexron or Dexron II in Power steering System.

2. Turn steering wheel back-and-forth to end of travel in each direction several times; then recheck fluid level and add fluid, if necessary.
3. Install vented fill cap.

⚠CAUTION

DO NOT operate engine without water being supplied to seawater pickup pump or pump impeller may be damaged and subsequent overheating damage to engine may result.

4. Start engine and run at fast idle (1000-1500 RPM) until engine reaches normal operating temperature. During this time, turn steering wheel back-and-forth to end of travel in each direction several times.
5. Position drive unit so that it is straight back and stop engine. Remove fill cap from pump. Allow any foam in pump reservoir to disperse, then check fluid level and add fluid, as required, to bring level up to "Full-Hot" mark on dipstick. Do not overfill. Re-install fill cap securely.

IMPORTANT: Drive unit must be positioned straight back and Power Steering fluid must be hot to accurately check fluid level.

6. If fluid is still foamy (in Step 5), repeat Steps 4 and 5 until fluid does not foam and level remains constant.

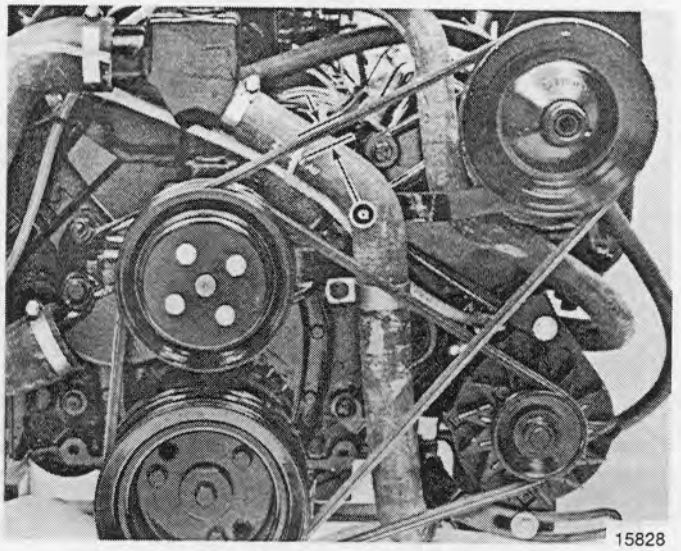
Drive Belt Tension

IMPORTANT: Refer to Precautions in this section before proceeding.

POWER STEERING PUMP

IMPORTANT: Do not pry on pump body.

1. Install drive belt on pulleys and adjust tension as follows:
   a. Pivot pump to attain tension.
   b. Tighten retaining bolts and check belt tension.
   c. Depress belt as shown to check tension. Re-adjust as required.



15828

a - 1/2" (12mm)

Important Service Information

METRIC PUMPS

Power Steering pumps are metric. All hose fittings and atttaching hardware are also metric. Listed is the metric mounting studs for the MCM V-6 engine.

MCM - V-6 Engine 16-41877

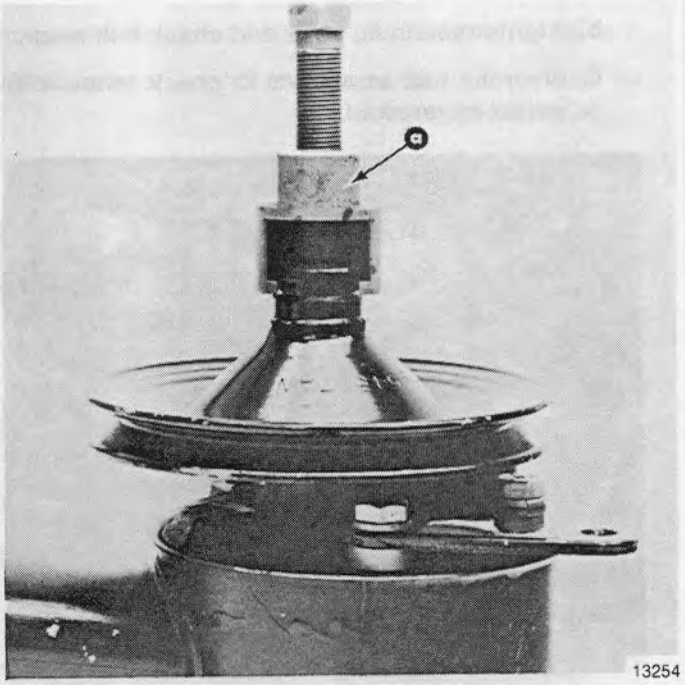
A different O ring P/N 25-89879 is used to seal the metric Power Steering pump pressure hose.

PUMP PULLEY

Replacement

1. Kent Moore Tool (P.N. J-25034) must be used to remove the pulley used on Power Steering pumps. This tool has an end on it that will not mushroom the end of the pump shaft.

IMPORTANT: Do not use Kent Moore Tool (P/N J-21239) to remove these pulleys. This tool has a tapered end and will damage the shaft.

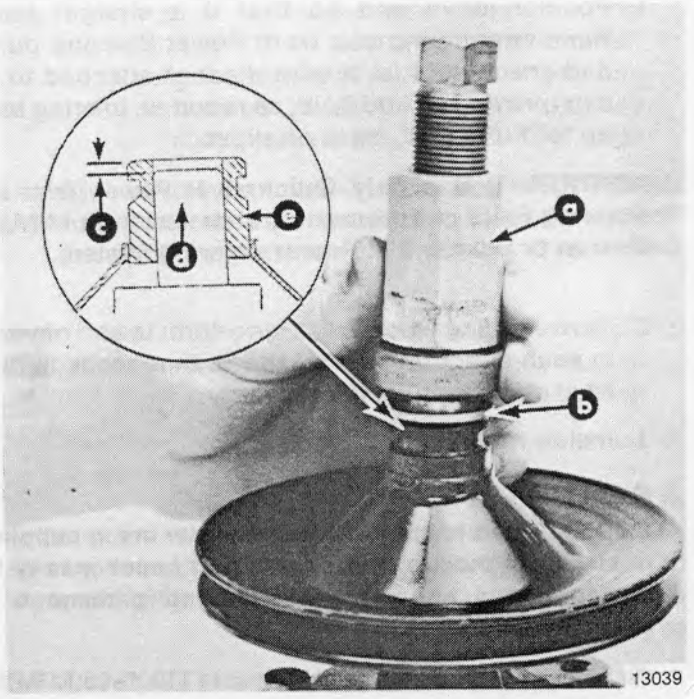


a - Pulley Removal Tool

2. The pulley pusher tool (91-93656A1) is used to install pulleys on Power Steering pumps. Pusher tool automatically positions Power Steering pump pulley at correct depth which is essential to obtain proper drive belt alignment. Proceed as follows:
   a. Place pulley on pump shaft.
   b. Place spacer on pulley with side stamped toward pulley.
   c. Place ball bearing on spacer.
   d. Thread pulley pusher shaft all the way into pump shaft.

IMPORTANT: Pusher shaft must be threaded all the way into pump shaft or damage to pump/pusher shaft threads may occur.

   e. Turn large pusher nut until spacer bottoms out on pump shaft. Check pulley installation for correct pulley depth.



a - Pulley Pusher Tool
b - Spacer
c - This Dimension is .200" (5.1mm)
d - Pump Shaft
e - Pulley

Pump Repair

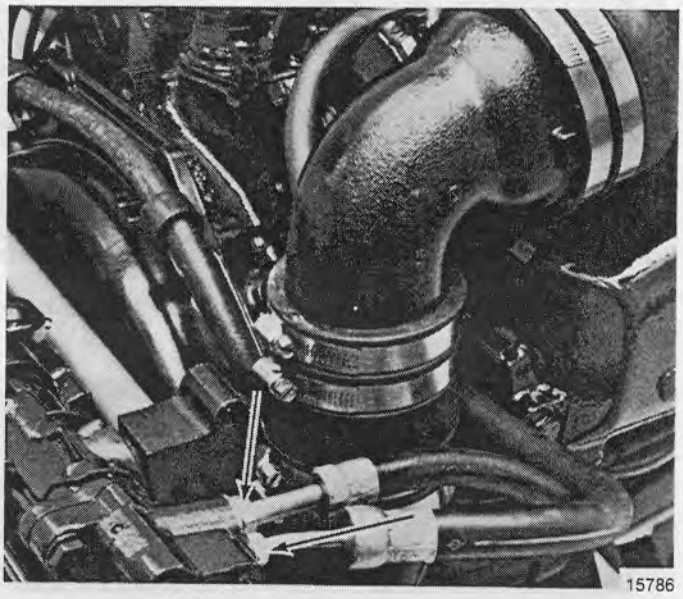
NOTICE
For pressure checks and repairs refer to appropriate "Stern Drive Service Manual".

Power Steering Pump and Cooler

REMOVAL

IMPORTANT: Retain all hardware for future installation.

1. Disconnect hydraulic hoses.


15786

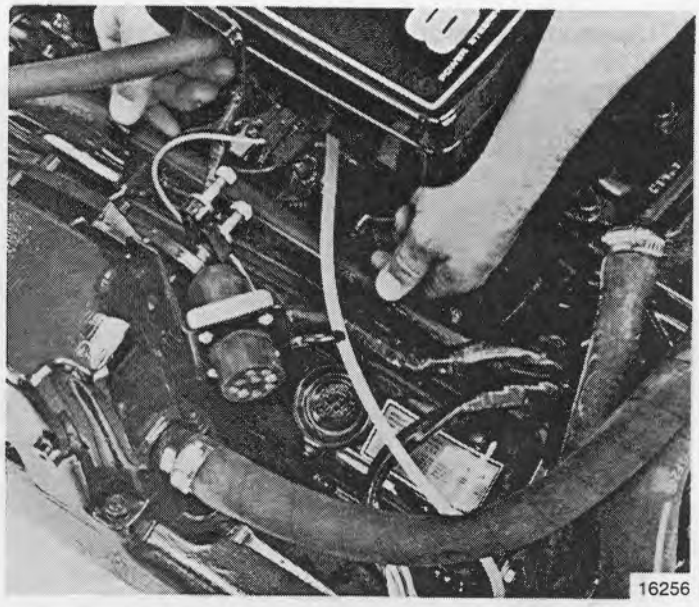
2. Cap connections on hoses.

16244

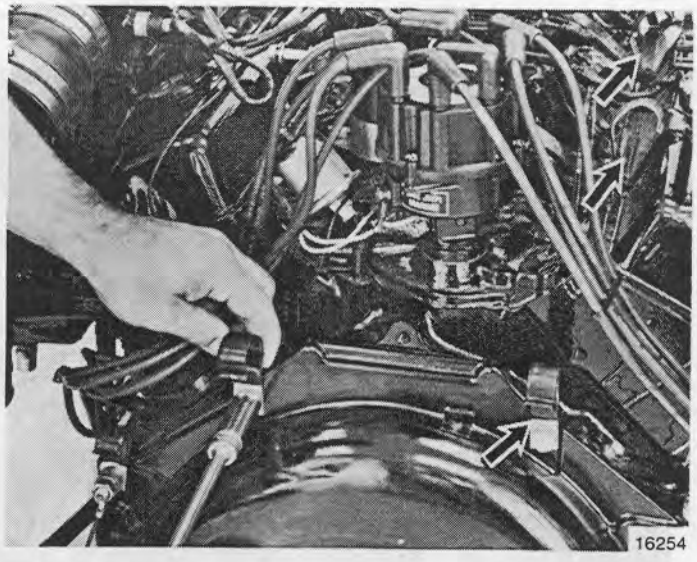
3. Remove low pressure hose.

16255

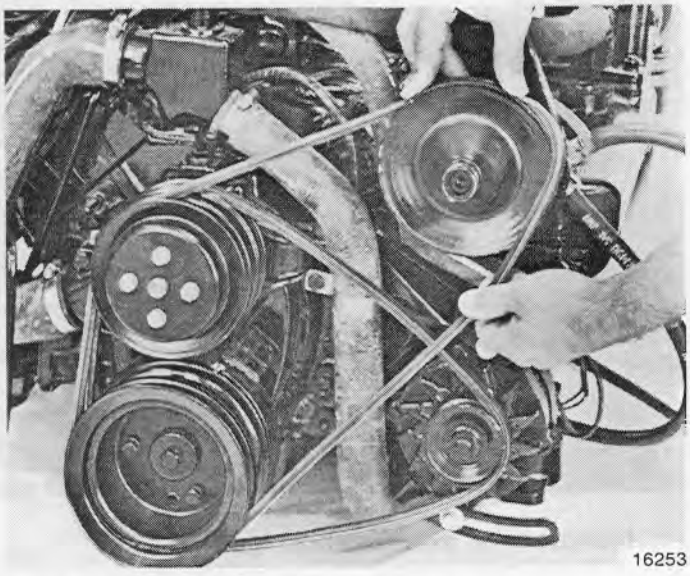
4. Remove high pressure hose.


16256

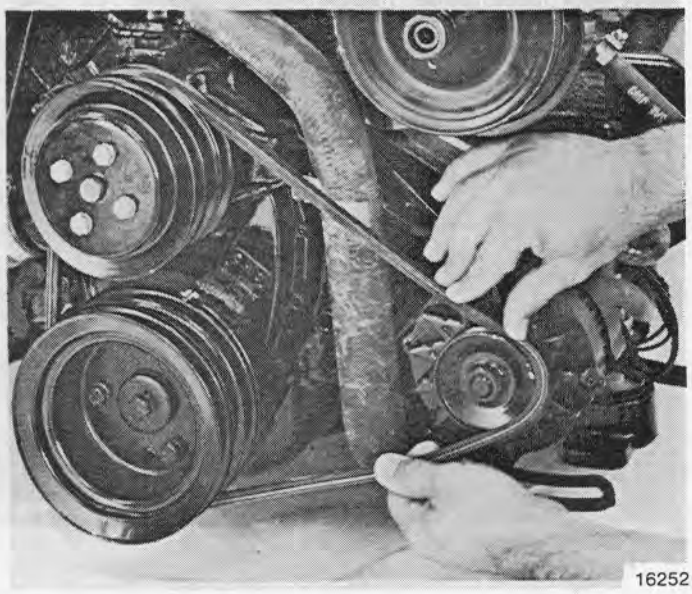
5. Remove J-Clamps and retain.


16254

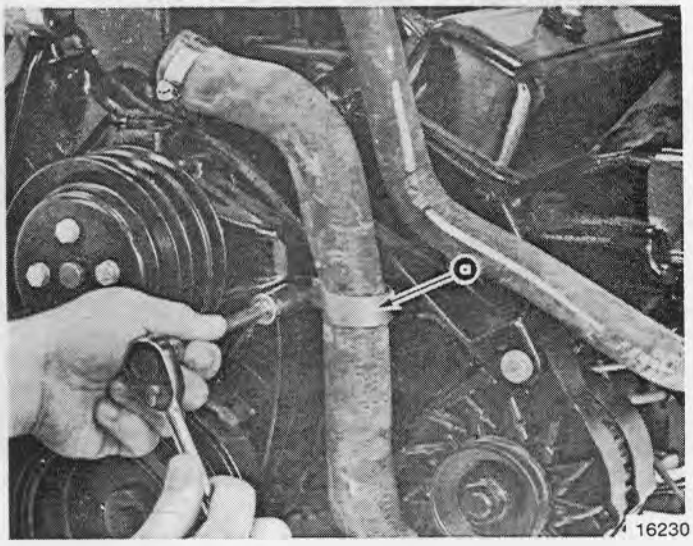
6. Loosen pump and remove Power Steering belt. Retain belt.


16253

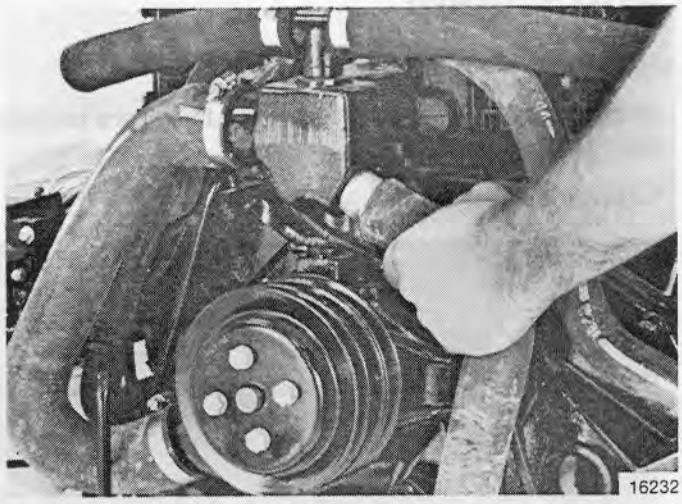
7. Loosen alternator, remove belt. Retain belt.


16252

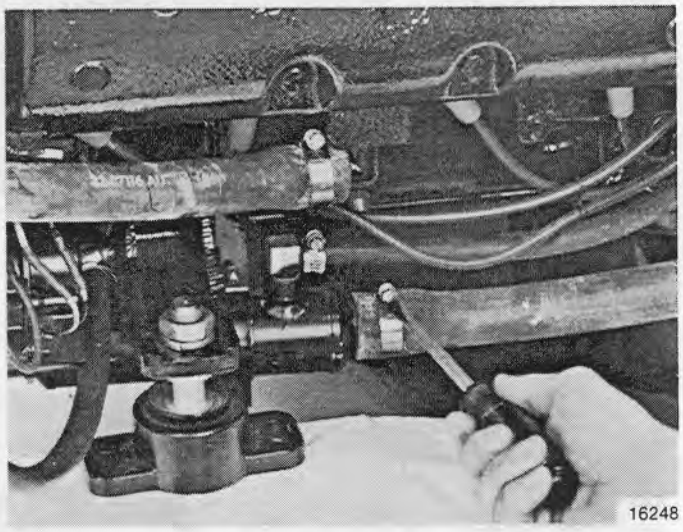
8. Remove hose clamp and retain.


16230

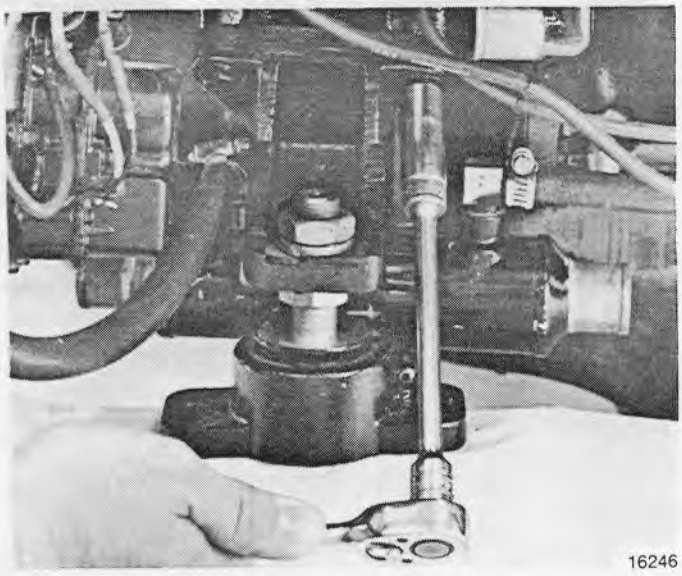
9. Remove hose from thermostat housing. Retain clamp and hose.


16232

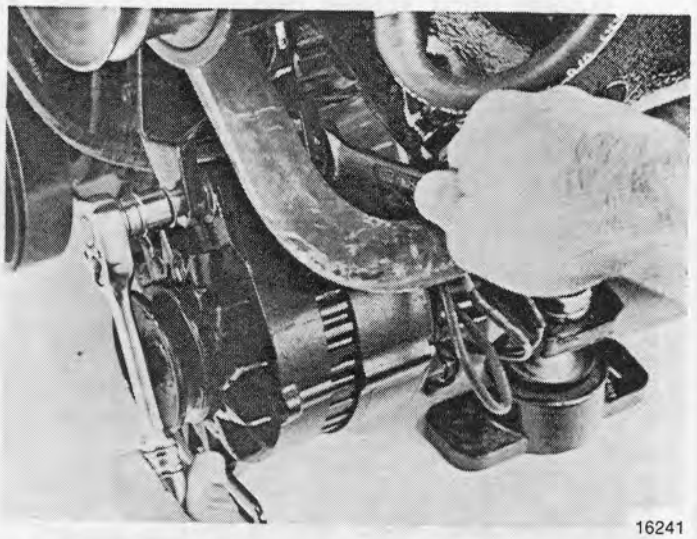
10. Remove transom gimbal housing to oil cooler hose from oil cooler.


16248

11. Remove oil cooler and bracket.

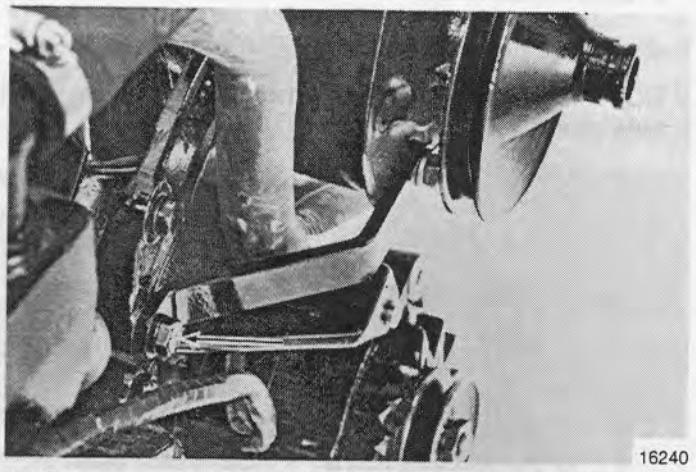

16246

12. Remove alternator from bracket.



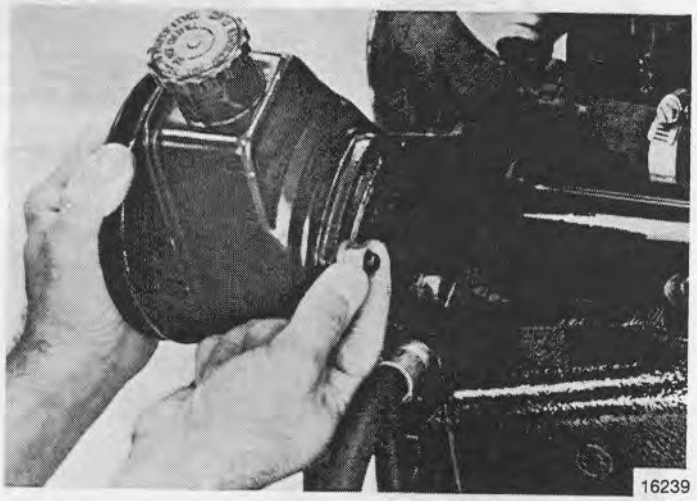
16241

13. Remove Power Steering pump brace from engine.



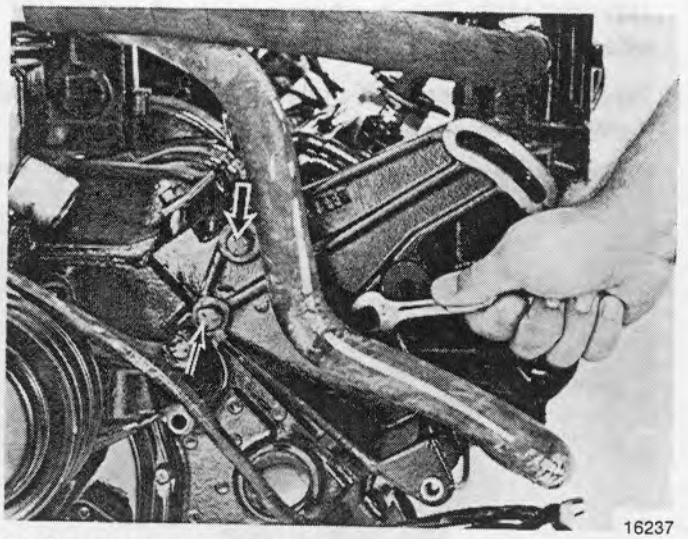
16240

14. Remove pump from bracket (earlier style bracket shown).



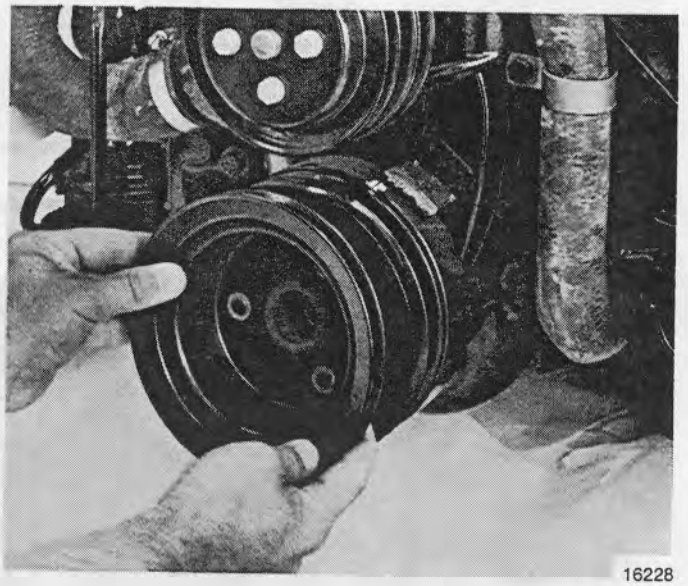
16239

15. Remove bracket, retain bracket and screws.



16237

16. Remove single groove pulley, and retain pulley and screws (earlier style pulley shown — later style is cast as a 1-piece pulley).

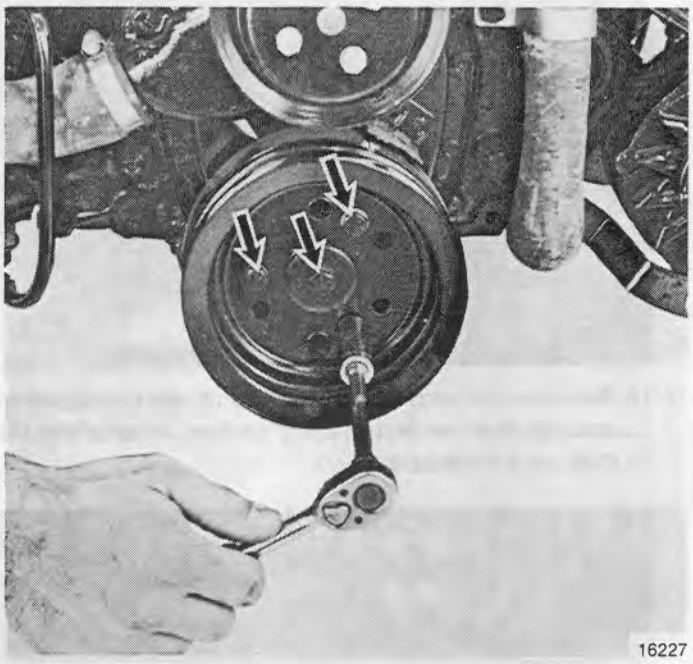


16228

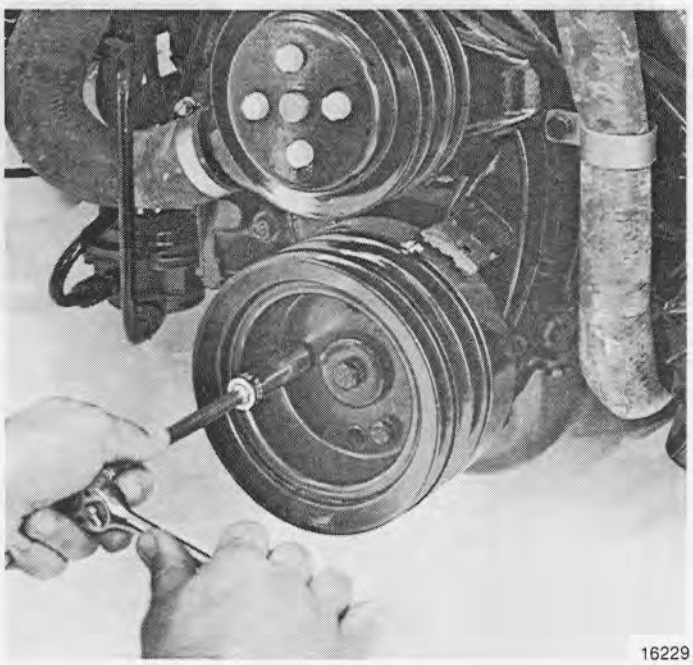
INSTALLATION

IMPORTANT: Use hardware retained previously to attach Power Steering.

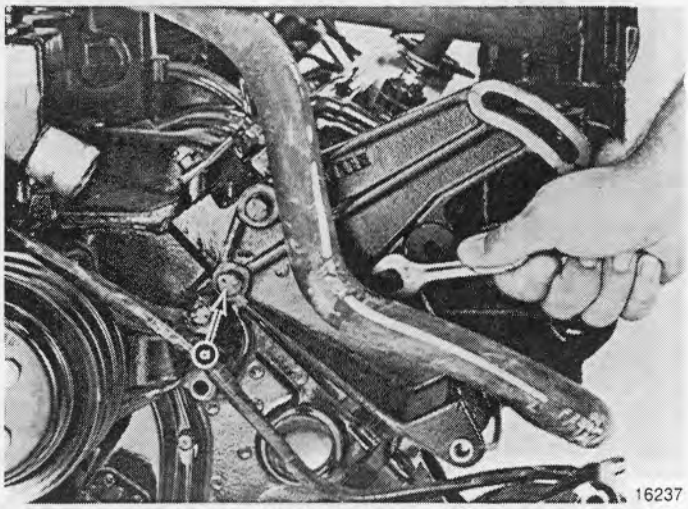
1. Remove crankshaft pulley attaching screws (discard screws).


16227

2. Install single groove pulley, using 3 long screws retained from removal of single groove pulley.


16229

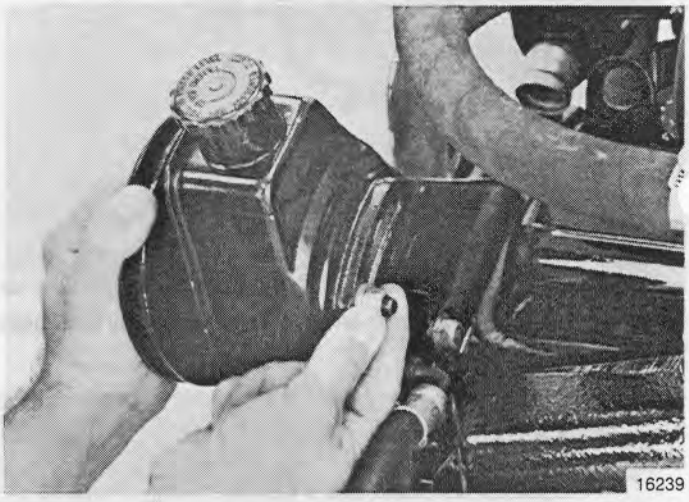
3. Install Power Steering pump/alternator mounting bracket using screws originally removed with bracket.


16237

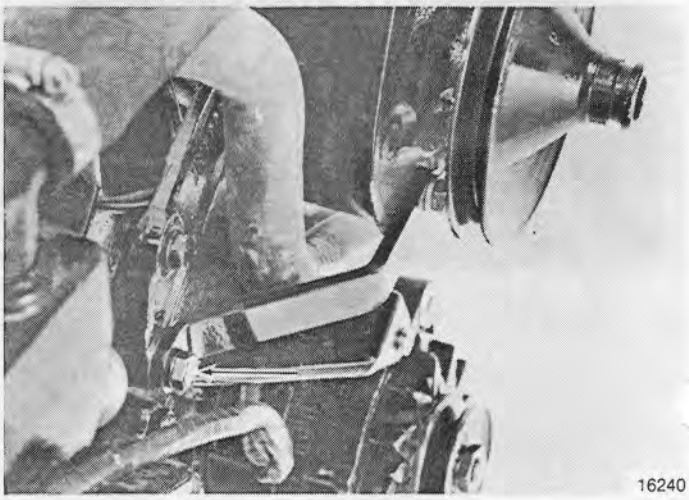
a - Leave This Screw Out

4. Secure pump to bracket.

NOTE: Pump is secured with two metric nuts (usually blue in color) and washers.


16239

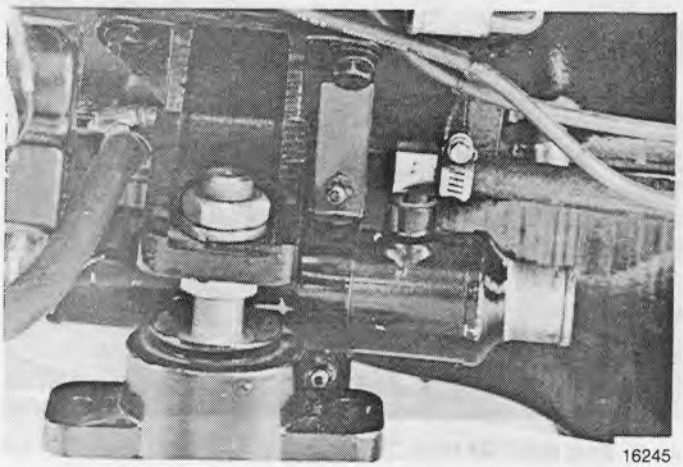
5. Attach Power Steering pump brace with bolt retained at removal.


16240

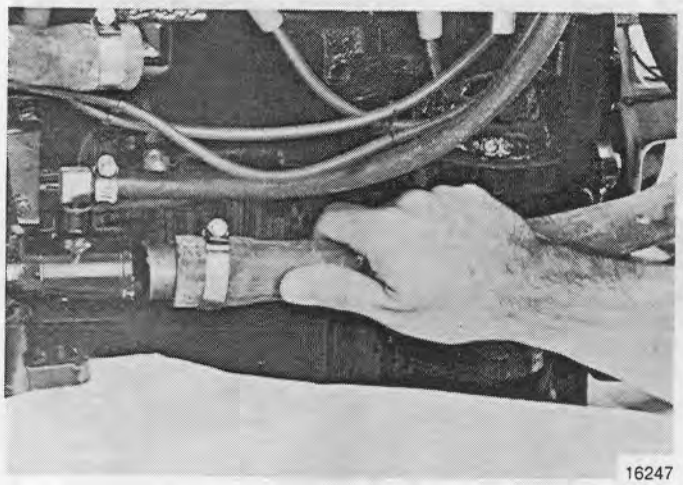
6. Install oil cooler to block using screw previously removed.

IMPORTANT: Flat washer must be placed between engine mount and cooler mounting bracket.

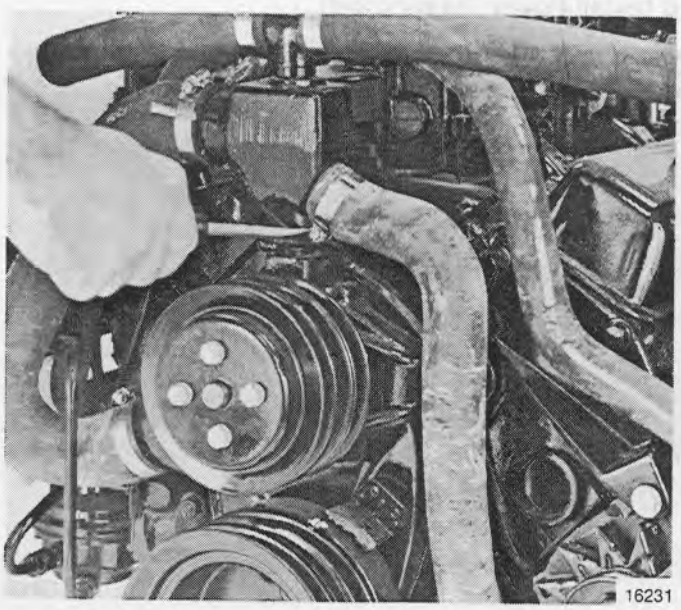
NOTE: On later models, cooler attaches to lower bolt on mount bracket.


16245

7. Install transom gimbal housing assembly to oil cooler hose and tighten hose clamp securely.


16247

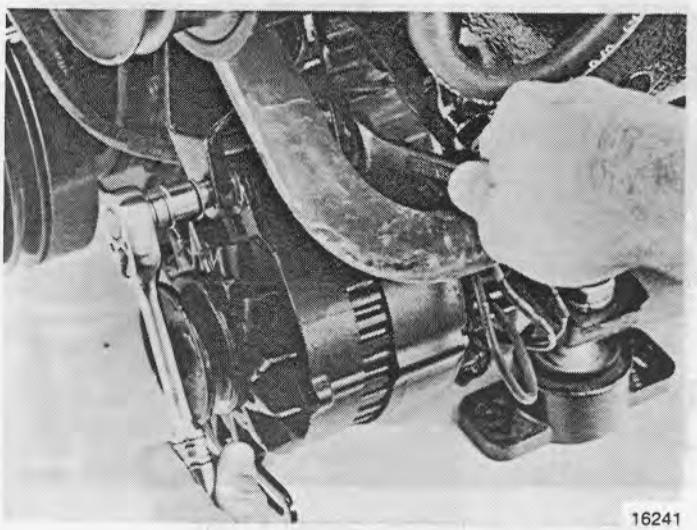
8. Install hose and tighten hose clamp securely.


16231

9. Install clamp, secure to circulating pump. Torque screw to 30 lbs. ft. (41 N.m).

16251

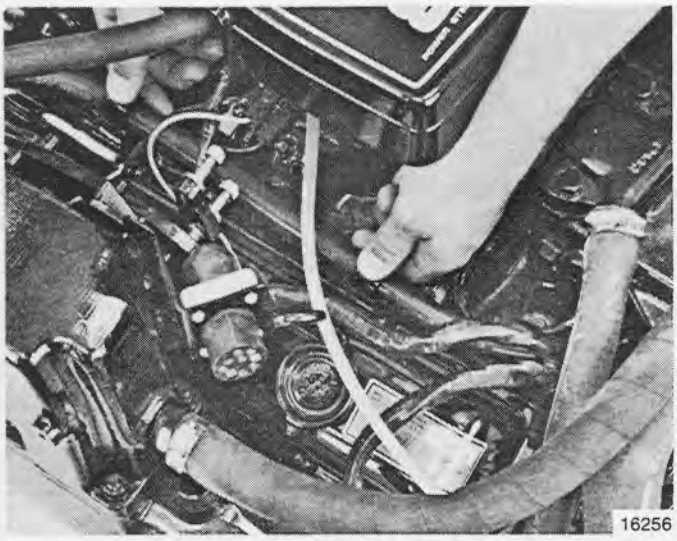
10. Attach alternator to bracket.


16241

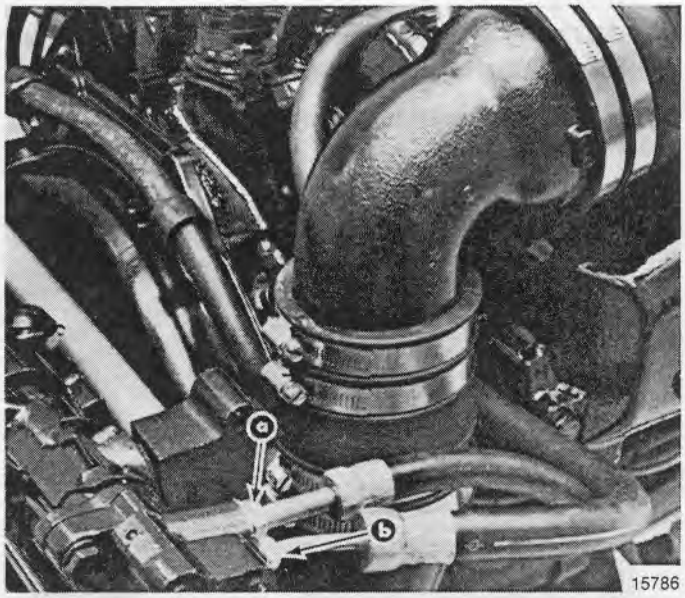
11. Install J-Clamps, tighten securely.

12. Install J-Clips and route and secure low pressure hose.

13. Route and secure high pressure hose.



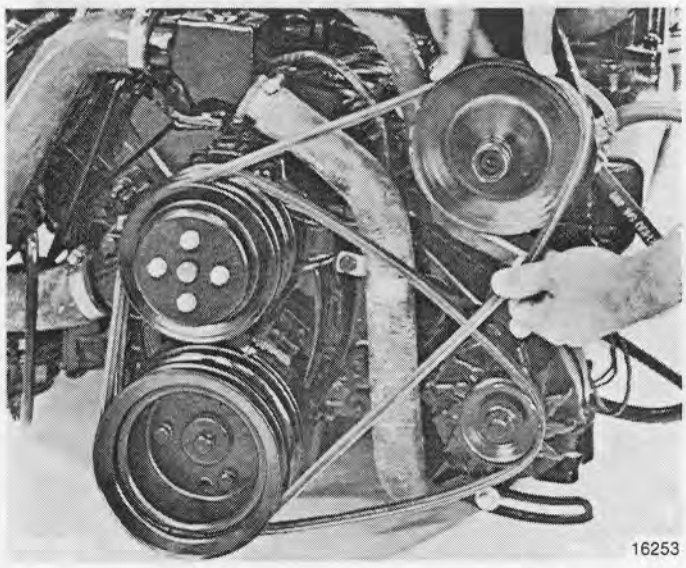
14. Secure and torque hoses.



a - 20-25 lb. ft. (27-34 N.m)
b - 96-108 lb. in. (10.8-12.2 N.m)

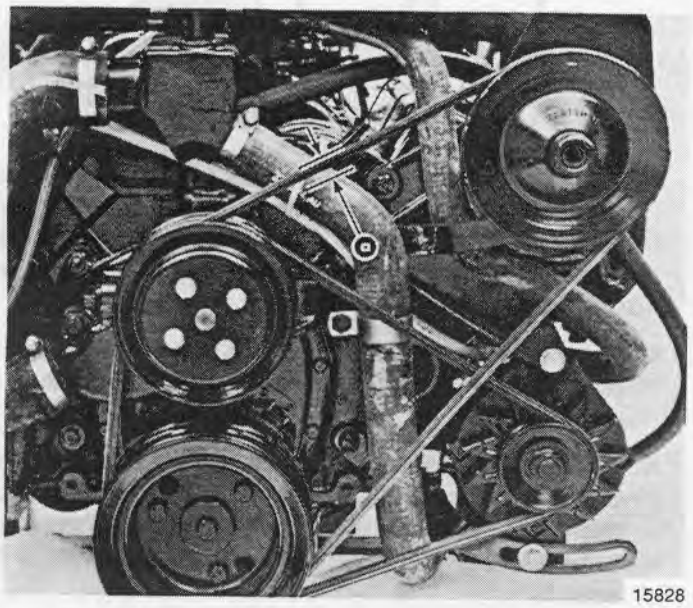
15. Install Alternator drive belt.

16. Install Power Steering belt.



17. Adjust Power Steering pump belt.

IMPORTANT: Do not pry against side of pump, as damage may result.

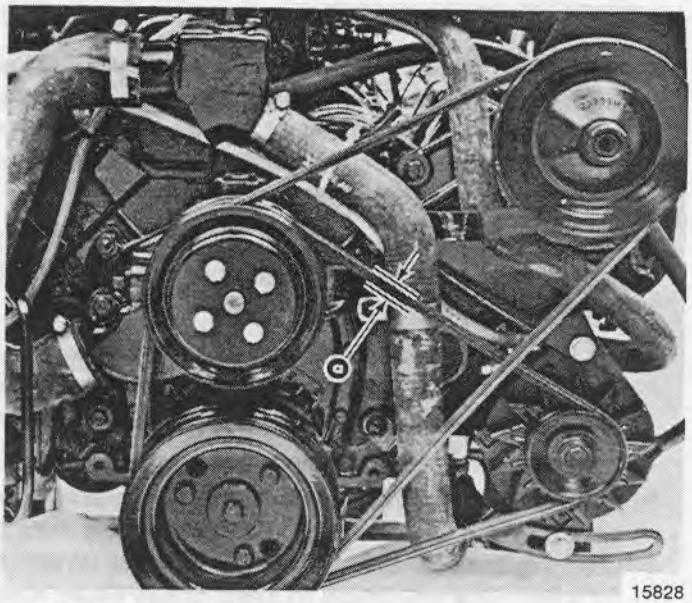


15828

a - 1/4" (6mm)

18. Adjust alternator belt.

IMPORTANT: Do not pry against rear end frame, as alternator may be damaged.



15828

a - 1/4" (6mm)

Fill and Bleed Power Steering

IMPORTANT: Power Steering system must be filled exactly as explained, following, to be sure that all air is bled from the system. All air must be removed, or fluid in pump may foam during operation and be discharged from pump reservoir. Foamy fluid also may cause Power Steering System to become spongy, which may result in poor boat control.

1. Remove filler cap from Power Steering pump and look into pump reservoir. If fluid is not visible, add fluid, as required, until fluid covers casting in pump reservoir.
2. Turn steering wheel back-and-forth to end of travel in each direction, then recheck oil level and add fluid, as required, until it again covers casting in reservoir.

⚠CAUTION

DO NOT operate engine without cooling water flowing thru seawater pickup pump in drive unit, or pump impeller may be damaged and subsequent overheating damage to engine may result.

⚠WARNING

DO NOT check fluid level while engine is running, as hands and clothing could get caught in V-belts and pulleys.

3. Install fill cap, start engine and run at idle speed. Turn steering wheel back-and-forth to end of travel in each direction several times, then position steering wheel so that drive unit is straight-ahead and stop engine. Allow any foam in pump reservoir to disperse, then check fluid level with dipstick (attached to fill cap). Add fluid, as required, to bring level up to "Add" mark (on pumps with metal fill cap) or "Full-Cold" mark (on pumps with plastic fill cap). Do not overfill. Reinstall fill cap.
4. Restart engine and run at fast idle for approximately 10 minutes. During this time, turn steering wheel back-and-forth to end of its travel in each direction several times.
5. Position drive unit so that it is straight-ahead and stop engine. Allow any foam in pump reservoir to disperse, then recheck fluid level with dipstick. Add fluid, as required, to bring level up to "Full" mark (on pumps with metal fill cap) or "Full-Hot" mark (on pumps with plastic fill cap). Do not overfill. Reinstall fill cap securely.

IMPORTANT: Fluid in Power Steering pump must be hot, and drive unit must be positioned so that it is straight-ahead to accurately check fluid level.

6. If fluid was foamy in Step 5, repeat Steps 4 and 5 until fluid no longer becomes foamy and level remains constant.

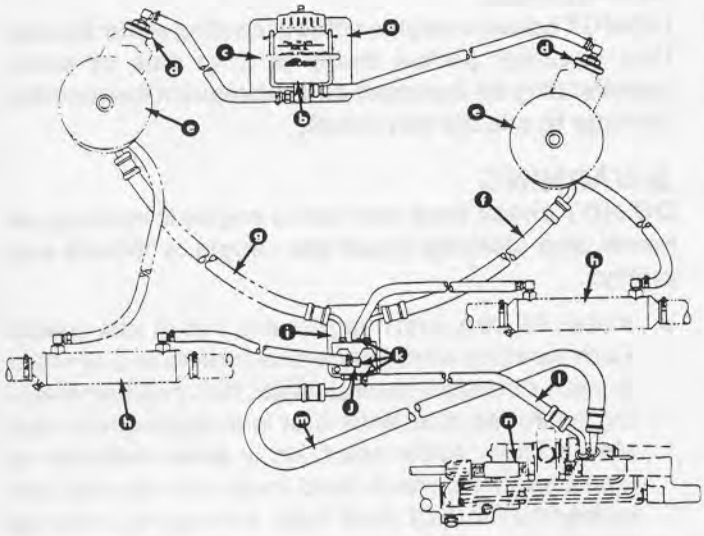
Priority Valve Kit (79691A1)

IMPORTANT: This kit is for use on Dual Installations where both engines are equipped with Power Steering pumps, Coolers, related hardware and hoses and one Transom assembly is equipped with Power Steering.

INSTALLATION

Installing Reservoir

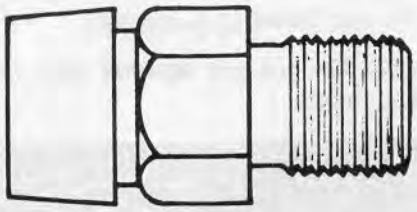
1. Mount reservoir bracket to transom with 2 screws (from kit) halfway between the 2 Power Steering pumps in a location that affords both accessibility and visual inspection of reservoir oil level. Be sure that location is at least 6" (150mm) higher than pumps and is far enough away from any obstruction that might prevent mounting of priority valve. Priority valve must be mounted no closer than 2" (51mm) from bottom of reservoir.



a - Reservoir Bracket
b - Bottle Reservoir
c - Retainer Spring
d - Cap Assemblies
e - Power Steering Pumps
f - Secondary Pressure Line
g - Primary Pressure Line
h - Coolers
i - Priority Valve Bracket
j - Priority Valve
k - 90° Elbows
l - Return Hose from Kit
m - Pressure Hose from Kit
n - Power Steering Control Valve

2. Position bottle reservoir in mounting bracket and secure with retainer spring from kit.

IMPORTANT: The two-way check valve is required for cold weather operation below 40° F (4° C). Remove vent from reservoir cover and replace with two-way check valve, if conditions require. [It is not necessary to replace vent if temperature is above 40° F (4° C), unless reservoir overflows during operation.]



Two-Way Check Valve

3. From bulk hose (supplied with kit; hose without fittings), cut 2 hoses of sufficient length to extend from bottom of reservoir to fill caps on pumps. Allow enough extra hose for routing and installation of cap assemblies.
4. Secure hoses with sta-straps to keep them below reservoir and away from excessive engine heat and moving parts.
5. Position hose clamps over ends of hoses, connect one end of each hose to reservoir and other end of each hose to a cap assembly. Tighten hose clamps securely. DO NOT fasten caps to pumps at this time.

INSTALLING PRIORITY VALVE

1. Install valve mounting bracket with 5/16-9 x 2" (51mm) lag bolts and washers (from kit) in a central position under reservoir. Be sure that location will allow 2" (51mm) or more between priority valve and reservoir when priority valve is mounted to bracket.
2. Install 90° elbows (from kit) into priority valve (at locations marked "T"), using location of coolers, and Power Steering control valve as guides for direction of elbows. Use liquid pipe joint sealer to seal connections and tighten fittings securely.
3. Secure priority valve to bracket with 5/16-18 x 2-3/4" hex head bolts, nuts and washers from kit. Tighten securely.
4. From bulk hose (supplied with kit; hose without fitting), cut 2 hoses of sufficient length to extend from Power Steering cooler to respective fitting on priority valve.
5. Position hose clamps over ends of hoses and connect one end of each hose to its respective Power Steering cooler and the other end to fitting on priority valve. Use sta-straps to keep hoses away from excessive engine heat and moving parts.
6. Install hose (fitting on one end only, from kit) to Power Steering control valve. Route hose to priority valve, then cut hose to length, position hose clamp over end and install hose to its respective fitting.
7. Install hose (with fittings on both ends, from kit) between Power Steering control valve and "S" (large) position on priority valve.
8. Install both pressure hoses (leading from pumps) to "S" (small) locations on priority valve, as shown.

Filling System with Fluid

1. Remove shipping caps from pump reservoir (if not already removed) and fill reservoirs with Quicksilver Power Trim and Steering Fluid or Automatic Transmission Fluid (ATF), Type F, Dexron, or Dexron II.
2. Install caps (from kit) on pump reservoir so that after twisting each cap 120°, the fitting (hose) is facing forward (away from engine block).
3. Fill bottle reservoir to full mark, then (one at a time) twist and remove caps (hold cap above pump reservoir). Allow fluid to flow through line into pump reservoir. When pump reservoir is close to overflowing, reinstall cap as described in Step 2. Fill bottle reservoir and repeat process for other cap.
4. Torque large nut on cap to 6 ft. lbs. (8 N.m) to secure cap to pump reservoir.

⚠CAUTION

While pump is operating, DO NOT turn steering wheel left or right until Step 5 is completed, or air will be induced into control valve.

5. With the boat in the water or cooling water hooked up, start one engine. Add any fluid required to maintain reservoir level. Should growling in pump or foaming of fluid occur, stop engine and allow fluid to settle for 5 to 10 minutes. Refill bottle reservoir and repeat procedure for other engine.
6. After the air is worked out of the system and the bottle reservoir maintains its level, check the function of the valve as follows:
   a. Start the first engine and turn steering wheel while checking for power assist.

IMPORTANT: Maintain oil level in bottle reservoir while checking valve function.

   b. Start second engine and turn steering wheel, checking for power assist.
   c. Stop engine No. 1 and turn steering wheel while checking for power assist.
   d. Start engine No. 1 and stop engine No. 2, then turn wheel and check for power assist.
7. After checking function of valve stop engine; check all connections for tightness.